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INDUSTRIAL MEDICINE AND SURGERY—A RÉSUMÉ OF ITS DEVELOPMENT AND SCOPE*

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THE last decade has witnessed the birth of a new specialty in the medical profession—Industrial Medicine and Surgery. The majority of specialties in medicine tend to develop the physician along some specific line to the exclusion of the other branches of practice. To this highly specialized study the great scientific advancements in medicine owe their origin. On the other hand specialization has had a decidedly narrowing influence upon the great leaders of the profession causing them to lose sight of the human side of their work, exemplified so pre-eminently by the old-time family physician.

This new specialty of industrial medicine and surgery includes every scientific branch of medicine and in addition requires a keen understanding of practical sociology. Its field is so broad that it involves specialists within this specialty—yet each worker in this field must be thoroughly trained in its general aspects.

The problems of the family physician concerned the individual and the family. The problems presented to the industrial physician concern the individual, the family, and the large group associated with him—his fellow-employees and employer.

Specifically the scope of this work deals with the human maintenance equation in industry. It involves the prevention of disease and accidents among the entire group of employees; the constant supervision of the health of the employees, including a study of each individual, the working conditions, the hazards of each occupation, the question of hours of labor and wages, the daily intercourse between the employer and the employed as well as between fellow-employees, and the home environments of the working force; adequate medical and surgical care of the sick and injured; compensation and benefits during periods of disability; the selection of occupations according to the physical qualifications of the individual; the restoration of the disabled to an economic usefulness; it involves, in fact, every human equation in this problem which affects the health and efficiency of the individual or of the entire group of employees.

With the development of this specialty we are approaching nearer and near the ideal expressed by Juhnke when he said: "And the end is that the workman shall live to enjoy the fruits of his labor; that his mother shall have the comfort of his arm in her age; that his wife shall not be untimely a widow; that his children shall have a father; and that cripples and helpless wrecks who were once strong men, shall no longer be a by-product of industry."

As each country entered the great world war it was confronted with two all-important necessities, the conservation of man-power and maximum production in the essential industries. Our nation was confronted with the same problems. At first, in the great efforts to overcome our unpre-

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paredness, we were prodigal to the extreme, especially in the matter of conserving the forces of our industrial army.

But more and more as the months went by, the principles of industrial medicine and surgery came to be recognized as essential in procuring maximum production. From a specialty known only to a few hundred physicians and whose value was recognized only by those industries employing medical services, it rapidly became a measure in the national preparedness program. To-day the language of the industrial physician is spoken familiarly by thousands of physicians and laymen.

With the prospect of hundreds of thousands of maimed soldiers being returned to our shores from the conflict overseas, the government began to prepare for the reconstruction of these disabled men. Here again, industrial surgery found a field for the application of principles demonstrated as practical and sound in a few of our great industries. But the work of reclaiming the disabled soldiers has gone far beyond the practices in industry; now the broadened principles of this work must be applied to all disabled from industry.

The conservation of man-power and the reclamation of disabled men bid fair to become two of the greatest by-products of this war. Too often in the past the maimed from industry were relegated to the human scrap-heap. They were given mediocre jobs where all incentive for endeavor or future advancement were lacking, or, as often happened, they were allowed to drift with the current into the great army of beggars and derelicts.

The nation is at last awakened to its wasteful attitude toward men disabled from industry. To-day the creed of the disabled soldier will be adopted by the handicapped workers of the land because at last they will be given a chance instead of charity: Once more to be useful—to see pity in the eyes of my friends replaced with commendation—to work, produce, provide, and to feel that I have a place in the world—seeking no favors and given none—a Man among Men in spite of this physical handicap.

Thus it is quite evident that the specialty of industrial medicine and surgery, is in fact the best medical and surgical practice, the best preventive medicine and preventive surgery, combined with the best social and economic principles, all applied to a large group—the working men and women of our nation—approximately forty million people. With its rapid growth it is becoming the greatest public health service yet offered to our people.

HISTORY OF ITS DEVELOPMENT

This form of public health service was rarely mentioned prior to ten years ago. To-day it is receiving the greatest attention from physicians, industrial engineers, social workers and employers in general. Medical schools and engineering schools are teaching students various phases of industrial medicine and surgery. Every year witnesses the enactment of new laws by state legislatures tending to improve or protect the health, welfare, and comfort of workmen. In fact, few subjects have received such widespread attention, or have reacted for greater good to the nation in so short a time.

For decades certain industries have had their company surgeons. These men, working under contract, usually inadequately paid, and frequently considering their industrial practice as only a side-issue, did not grasp the opportunity for service offered by their positions. As a rule their work was limited to emergency surgery—the repair of the broken human machine after the damage had been done.

In 1911, the writer made a careful study of the various state laws dealing with industry and labor. While a few states had acts covering some of the fundamental principles of health protection among working forces, yet evidently no state had made a serious study of this problem.

The report of the Department of Commerce and Labor for 1909 and a study of the various labor laws showed that only twenty-one states had acts bearing directly upon the subject of factory and workshop sanitation. Eight of these states, however, limited their vision of the subject to this order, "All work-shops must have proper ventilation and proper sanitary conditions," but none of them made specific recommendations as to what constituted "proper." Six of the twenty-one states designated the amount of air space per person and made a few specific requirements covering sanitary conditions. At least five were very specific in their requirements for the removal of injurious

gases or dusts; two provided for the cleansing of the interior of the work-shops; and one only had a law against overcrowding factories and work-rooms.

Most of these states provided for factory inspectors, but these were all laymen, usually untrained in the scientific principles of protecting the health and limbs of employees. This résumé of the various state labor laws at that time deeply impressed one with the great lack of preventive legislation — legislation which, if enacted and enforced, would greatly reduce the death rate among the wage earners and coincidentally improve the hygienic and economic conditions of every community.

In the eight years since this study was made practically every state in the Union has enacted laws seeking to improve the working conditions of employees. In that short period thirty-seven of our states have enactments on employees' compensation; recently a few have included occupational diseases under the causes for compensation. To-day, at least eight states are considering laws for workmen's insurance against sickness and an equal number for the rehabilitation of disabled workmen.

These various laws have been responsible for the installation of comprehensive medical services in many large industries; they have improved industrial health conditions to a great extent. However, a résumé of the laws to-day still impresses one with the great lack of preventive legislation. The crying need is for a thorough study of this entire field and, instead of piece-meal legislation, the enactment of a standardized law in every state which would cover the absolutely essential features of a comprehensive industrial health service.

Although the legislative advancement along these lines has been slow, yet voluntary efforts by individuals, national organizations, many large industries, and by a few state Departments of Industry and Labor have rapidly advanced this new specialty. Prior to 1909, a few state factory inspectors and a few other individuals had called upon the nation to witness the wastage of human life, due to some of the more blatant unsanitary conditions in industry. Beginning with this year, and especially during 1911 and 1912, a great incentive was given to this subject by the writings of a number of physicians connected with industrial concerns.

These writings dealt chiefly with the subject of physical examination of employees, and with other methods for supervision of their health. One of the earliest examples recorded of a careful effort at supervision of the health of a group of workmen was that made by Dr. Frank Fulton, in Providence, R. I., in 1906. This physician examined, free of charge, a number of employees in one of the big saw factories for the purpose of discovering tuberculous workmen.

In 1909, the writer introduced the examination of employees in the concern of Sears, Roebuck & Co., of Chicago. The inception of this work was perfectly natural—an employee, with an injured hand, reported to the doctor's office during the second week of my work with this plant. While dressing the injury it was noticed that the general appearance of this employee was bad; examination was made, and an advanced stage of tuberculosis discovered. This led to an examination of the fellow-employees working in close contact with this man. Three other cases of tuberculosis were discovered in his department within a short time, and the adoption of a thorough examination of the employees naturally followed. It soon became evident that such examination would reveal many other diseases, which, taken in their incipiency, could be checked. From this fact arguments with the strongest economic basis were easily advanced in favor of all physical examination of all employees. Similar reports, setting forth the benefits of this practice, were made about the same time by Dr. Irving Clark of the Norton Grinding Co., of Worcester, Mass.; by Dr. Otto Geier of the Cincinnati Milling Machine Co.; by Dr. Wilbur Post of the People's Gas Co., of Chicago; by Dr. C. G. Farnum of the Avery Co., Peoria, Ill.; by Dr. S. M. McCurdy of the Youngstown Sheet and Tube Co.; by Dr. Lowe of the Goodrich Rubber Co., and by other workers in this field. By 1914, physical examinations of employees were a fixture in many industries.

The Committee on Factories of the Chicago Tuberculosis Institute, composed of Drs. James Britton, Theodore Sachs and Henry Faville, was instrumental in extending this system to a number of the

other industries of Chicago. Their report on this work, presented before the National Tuberculosis Association in 1914, gave a marked impetus to this branch of industrial medicine throughout the country. Since then the National Tuberculosis Association has been a staunch advocate of this form of medical work.

The studies of Dr. Thomas Crowder on ventilation, of Dr. Alice Hamilton on lead poisoning, of Dr. J. W. Schereschewsky and of Dr. George Price on health conditions among garment workers, and of men like Dr. E. R. Hayhurst and Dr. Francis Patterson working in connection with the Departments of Industry and Labor of the states of Ohio and Pennsylvania, respectively, stand out as milestones in the advancement of industrial health in this country, especially during the years 1910 to 1915.

In Milwaukee, Wis., during the week of September 30, 1912, there was organized the first National Safety Congress ever held in the United States. The birth of this great organization was due to the joint action of the Association of Iron and Steel Electrical Engineers and the Coöperative Safety Congress, and was given the name of National Council for Industrial Safety. The purpose of this organization was to devote every effort to the promotion of safety to human life in the industries in the United States. As its scope of activities broadened, the association changed its name in 1914 to *National Safety Council.*

Every physician and surgeon in the land, and especially those engaged in industrial practice, should be familiar with the history of this great National Safety Council. It has been the means of conserving thousands and thousands of lives. It has stimulated the medical profession to greater efforts in prevention. "Safety First" has become the twin brother of preventive surgery. Such physicians as Geier, Patterson, A. M. Harvey, Farnum, McCurdy, Lauffer, and L. A. Shoudy, early took a very active part in this new safety organization. Within the next two years many other surgeons in industry joined this movement. As a result, the *Health Service Section of the National Safety Council* was organized during the annual meeting of the Council in Chicago in 1914.

During this same period the surgical care of injured employees was advancing, due to the studies and contributions of such emergency surgeons as Moorhead, Clark, Farnum, Corwin, Harvey, Lauffer, Shoudy, Cotton, Bloodgood, Edward Martin, Lounsbury, Warnshius, Mock and others interested in industrial surgery.

In the American Public Health Association, Drs. W. A. Evans, E. T. Fisk, Alice Hamilton, E. R. Hayhurst, and B. S. Warren, with some fifty other physicians, recognizing the influence of this form of public health work formed the *Section on Industrial Hygiene* in that organization during the fall of 1914.

The year 1914 also witnessed the birth of the organization of the *Conference Board of Physicians in Industrial Practice,* under the secretaryship of Magnus Alexander. This organization was limited to the East, with headquarters in New York, and many of the leaders in industrial medicine and surgery were numbered among its members. Some of the greatest contributions to this specialty have been made by this group. During the same year reports emanated from the far West concerning the work being done toward improved conditions in our mining and lumbering industries. Such men as Dr. R. W. Corwin, Colorado, Drs. Tucker and Philip King Brown and R. T. Legge of California, Dr. Yokom of Washington, and a number of others, were responsible for these advances in the West.

For years the American Medical Association had frowned on the contract practices and other types of work of the company surgeon. The standard of this work in many instances had been far below par. But public recognition of this new specialty of industrial medicine was given in 1915 by this association. In the annual meeting of that year the Preventive Medicine Section of the American Medical Association (Dr. Otto P. Geier, chairman) had a symposium on industrial hygiene. Since then industrial medicine and surgery has had a place on every annual program of that section. In addition, last year the Orthopedic Section of the American Medical Association had a symposium on industrial surgery. The recognition of this work by the leading members of our profession testifies to the higher professional standard which it has attained.

At Detroit, Mich., in 1916, after a year of great effort on the part of twenty-five surgeons engaged in industrial practice in various sections of the country, there was organized the *American Association of Industrial Physicians and Surgeons*. The incorporation papers show 125 physicians and surgeons as charter members of this organization. Its aims have been to stimulate scientific study and research in all branches of industrial medicine, to stimulate industries to adopt a comprehensive health service, and to raise the standards of the physicians engaged in industrial practice. The combined efforts of this association have undoubtedly done more to increase the benefits from this work to both employees and employers than any other one agency which has entered this field. At present this organization has approximately 600 members.

In 1912, the United States Public Health Service formed its Division of Industrial Hygiene—now known as the *Division of Industrial Medicine and Hygiene*. For several years the work of this division was directed by Dr. J. W. Schereschewsky, now Assistant Surgeon General of the U. S. Public Health Service. More recently Dr. A. J. Lanza has been in charge of this division. Special investigations have been made in the garment, steel, various chemical industries, the grinding and cement industries, lead, coal, and copper mining, and a few others. The studies of this division have been responsible for establishing industrial hygiene in many diversified industries. This work has been greatly facilitated by the services of Dr. C. F. Rucker and Dr. B. S. Warren of the Public Health Service, and such consultants as David Edsall, George Price, Gilman Thompson, A. S. Stengel, C. D. Selby, Frederic S. Lee, Otto Geier, and many others.

The United States Department of Labor, within the last eight years, has rendered most valuable service to the country along various lines of industrial hygiene, through the work of Drs. Alice Hamilton, Royal Meeker, L. P. Cheney, Grace Meigs, and others. Exhaustive studies of this subject have been made, and the department's work on occupational diseases, accident hazards, fatigue, ventilation, lighting, child labor, hours of labor, and numerous other phases have formed a basis for correcting faulty conditions in many kinds of industry.

The Bureau of Mines has been engaged in a similar service in the mining industries of the country. These efforts of the national government to improve the hygienic conditions of the employees of the nation's industries are most praiseworthy. They mark the beginning of what must finally come to pass—a centralized supervision of health conditions throughout the country, not only among industrial employees but in all walks of life.

It is to be deplored that several federal departments are engaged simultaneously in this work of industrial hygiene. The desire to justify appropriations, to secure credit for doing a piece of work and the existence of certain inter-departmental jealousies which prevent proper co-operation between departments, all tend to duplication of effort and to retardation of results.

During the first three months following the nation's entrance into the war, many suggestions came to the government from the American Association of Industrial Physicians and Surgeons, the American Railway Surgeons' Association, the U. S. Public Health Service, and similar organizations, concerning the conservation of the industrial army for this great struggle. Most of these were referred to the Medical Section of the Council of National Defense. In October, 1917, Dr. Franklin Martin, Medical Director of the Council of National Defense, called a meeting of approximately fifty of the leading workers in the field of industrial medicine. As a result, there was organized an Advisory Committee on Industrial Medicine and Surgery, a sub-section of the Medical Section of the Council of National Defense. This committee proposed elaborate plans for the supervision of the health of all workers engaged in essential war occupations. Few of those in authority were familiar with this new field in medicine, and it took weeks and weeks of patient endeavor to sell the idea. On May 27, 1918, a committee was finally organized so as to include many diversified interests, a director was appointed, and a plan proposed which covered the scope of the work for the committee.

The following is a synopsis of this report, and shows how vital the program was

to the country's preparedness for war, and how more and more vital it would have become had the war continued longer:

INDUSTRIAL MEDICINE AND SURGERY AS A WAR MEASURE

Report of the Director: Dr. Otto P. Geier, May 27, 1918

The Need of the Hour—More production of war materials by the second line of defense.

Slowing Down of Industry Caused—

1. By excessive labor turn-over.
2. By physical breakdowns—
   a. Due to unsanitary conditions of shops and homes (lack of medical supervision).
   b. Due to lack of early recognition and prompt treatment of ailments leading to invalidism.
3. By absence from work—
   a. Due to preventable accidents.
   b. Due to lack of immediate medical and surgical care.
4. By lack of output because of those killed or permanently disabled.

Production Can be Definitely Speeded up by Protection of the Human Machinery from Preventable and Unnecessary Wear and Tear, Disease and Injury.

The non-effectives in the average industry are known to be at least 3 per cent., or thirty in each thousand, on account of sickness (study of 750,000 workers, U.S.P.H.S.: may go as high in others as 6 per cent. of non-effectives). Add to this factor an additional 2.5 per cent. for absence, falsely claimed to be due to sickness; then add 0.5 per cent. for absence on account of lost time due to accidents and we have a total absence of 6 per cent. to which medical men can direct their efforts.

The *principles* of *industrial medicine* and *surgery* intelligently applied can reduce this 6 per cent. to 3 per cent., making a gain of 30 workers on the job in every 1000.

Additional Saving—A cleaner plant and healthier workmen will result in a greater output per man.

Other By-Products—Better relations between employer and employee—more sympathetic understanding—comforts and conveniences, cafeterias, etc., supplied; all producing a better *esprit de corps* resulting in less labor turn-over.

The protection of the health of the community—women and children—quite as essential as the health of the workers. Fully 30 per cent. of the effective medical and surgical capacity of the profession has been drawn into the army. Twenty-four per cent. of the visiting hospital forces have been called into the service. This indicates that the civil population does not possess adequate medical service. Under strain of war conditions, disease and injury are increased. To meet this discrepancy, a method must be found by which every physician not in the army may give his maximum result with his minimum effort, so that the community may be adequately protected against disease.

The placing of the physician in industry accomplishes that need. Applying his preventive measures to the large industrial unit on an intensive scale, the industrial physician assists the community in its health efforts, lessens disease and therefore lessens the strain on the physicians in private practice.

Our Problem, Therefore, Is:

1. To meet the military need for greatly increased production.
2. To offset the drain on the man power in industry brought about by raising the military forces.
3. To assure adequate medical service for the civil population.

To Meet the Problem, the Government Must

1. Provide against unnecessary human waste in industry and society during the war.
2. Increase output by maintaining workers in good health.
3. Avoid preventable deaths and disabilities from accident and disease.
4. Restore to full producing power in the shortest possible time sick and injured workers.
5. Provide healthful places in which to work.
6. Provide healthful homes and communities in which to live.

Methods of Accomplishment:

Through the influence of the Advisory Committee and through the efforts of the Director, we should secure:

1. *Centralization and coördination*, with stimulation of all present agencies (federal, state and local).
2. *Enlistment and coöperation of the Public, of Industry and of Labor:* By a well organized educational campaign.
3. *Establishment of Standards.*
   a. Preparation and distribution of standards to cover the field of "Industrial Medicine and Surgery," emphasizing the occupational diseases of war industries.
   b. Establishment of minimum standards of plant dispensaries and medical personnel.
   c. Adoption of standard forms for use by industries in record of accidents and disease. (These records will be the basis for the first reliable and uniform statistics on morbidity and accident.)
4. *Personal Contacts.*
   a. Addresses before manufacturing and trade organizations—national associations, medical and social.
5. *Field Work* (Most important of all the measures.)
   a. Surveys of large industries engaged in war work by expert field workers, with recommendation to industries inspected. Copies of reports to go to that branch of the War Department interested in the output of that particular industry.
   b. Study of community sanitation to determine its responsibility toward the workers' health.
6. *Schools of Industrial Medicine and Surgery.*
   a. Propaganda to popularize courses of study for the specialty of industrial medicine and surgery in existing colleges.
7. *Legislation.*
   Study of industrial hygiene legislation of the several states for purposes of recommendation and standardization.

Personnel of Organization.

A Director (whose relationship to the committee shall be that of a president to his board of directors).

An Executive Secretary with industrial training and ability.

A Staff of Technical Advisors.

A Staff of Field workers—Present industrial force of P. H. S. greatly enlarged, and such additional men as our funds will permit.

A Staff of Speakers—volunteers.

The Advisory Committee on Industrial Medicine and Surgery.

Signed by the Committee:

Public Health Service, Dr. Joseph Schereschewsky, chairman.

Department of Agriculture, Dr. Carl L. Alsberg.

Department of the Interior, Mr. Van H. Manning.

Department of Commerce, Dr. W. A. Davis.

Department of Labor, Mr. Royal Meeker.

Organized Industry, Mr. Magnus Alexander.

Organized Labor, Mr. J. W. Sullivan.

Organized Medicine, Col. Charles H. Mayo.

Organized Industrial Medicine and the Army, Lt.-Col. Harry E. Mock.

Dr. Franklin Martin and Dr. F. F. Simpson, ex-officio.

By the efforts of a few members of this committee many of the above proposed projects were adopted by various governmental agencies. It was apparent from the start that no great progress could be made until this entire program, as well as other public health measures, were centralized under one agency. On July 1, 1918, the President issued an executive order, under the powers given him to coördinate the work of various departments, which stated that "All sanitary or public health activities carried on by any executive bureau, agency, or office, specially created for or concerned in the prosecution of the existing war, shall be exercised under the supervision and control of the Secretary of the Treasury." The only exception to this was the work of the medical departments of the Army and Navy. The order designated the U. S. Public Health Service as the bureau of the Treasury Department responsible for this work.

While the Public Health Service did not boldly take over every health agency of the government as prescribed in the above executive order, yet under this power they were able to extend the scope of their work, and to coördinate more closely with many of these agencies. The executive order was a step in the right direction, and if the war had continued would undoubtedly have led to great advances in public health, even to a national health administration.

Early in 1918, the Department of Labor underwent a reorganization. Its War Labor Administration Bureau took charge of the labor supply of the country, dealing it out and shifting it according to priority importance. This bureau interested itself in many of the health problems connected with labor. It coöperated with many of the state Departments of Industry and Labor, the State Council of National Defense, especially the Women's Division of the same, and many other organizations.

A Women's Division of the Department of Labor was organized under the direction of Miss Mary Van Kleeck. A committee representing the Office of the Surgeon General of the Army, the Ordnance Department, the Navy, the U. S. Public Health Service, the National Research Bureau, the War Industries Board, and other divisions of the Department of Labor, was formed in June, 1918, to act as the steering committee for the Women's Division. This committee made a thorough study of the occupational hazards for women workers in several specific industries. Many improvements in the working conditions of women were the results of this committee's activities.

The Ordnance Department organized a Division of Sanitation and Safety; the Railroad Administration formed its Safety Department; the Shipbuilding Board organized its Department of Medicine and Surgery, and other departments of the government were beginning to apply the principles of industrial medicine and surgery to their working forces before the signing of the armistice.

We have a few examples of an active interest on the part of state governments in industrial health conditions, but these are the first examples of an active, constructive federal program for introducing industrial hygiene into specific industries.

The great importance of this step may not be fully appreciated by many. But to those surgeons in industry who have devoted many years of their lives to establishing these principles, and to their lay allies, who have so thoroughly supported and abetted their efforts, the dawn of a new day has come; never again will we return to those dark ages when the human machine was worked to the limit without supervision and then prematurely scrapped because of a breakdown, often the direct result of the occupation.

During the last five years medical schools, recognizing the great opportunity for service offered to physicians in this field, have instituted courses covering some phase of the problem. Before the war Rush Medical College, Cornell University, the University of Pennsylvania, the University of California, and the University

of Ohio, were practically the only schools teaching some branch of industrial medicine. To-day at least six medical colleges are teaching some phase of this subject, and I know of four others contemplating the introduction of courses next fall.

The physicians and other workers in industrial hygiene cannot claim full credit for the developments in this field. A few large corporations, without the help or advice of medical men, voluntarily adopted improvements in the working conditions of their employees. A pioneer in this great effort was the National Cash Register Co., of Dayton, Ohio. The Norton Grinding Co., the Cincinnati Milling Machine Co., the Ford Motor Co., the International Harvester Co., the Avery Co., Crane & Co., the American Telephone & Telegraph Co., Sears, Roebuck & Co., and a few other large corporations were among the pioneer institutions which installed departments, including most of the principles embodied in a real human maintenance program.

As a result of these combined efforts of individuals, organizations, and certain employers on the one hand, and of the various state and federal agencies on the other, we are able to point to approximately 8,000,000 of the workers of the nation who are receiving, to a more or less degree, the benefits of this enlightened era in industry. But there still remain about 30,000,000 of our people who are responsible for production of some type in this country who are receiving no kind of health supervision. Many of these people are working under intolerable conditions. The amount of child labor still in use is unbelievable. The lack of protection against the commonest forms of occupational diseases is appalling.

Even in many of those concerns where maximum production was so essential for the winning of the war, inadequate housing conditions, unsanitary factory conditions, prevalence of occupational diseases, and a high accident rate, due to speeding-up and to green employees, were tolerated —inexcusable inefficiency at such a time. The labor turn-over in some of these concerns was over 500 per cent. To counteract this labor turn-over higher and still higher wages were paid—often defeating its purpose by increasing the turn-over. Even patriotism cannot overcome the bad influence on the working man of such intolerable conditions.

Each month of the war witnessed an improvement in many of these concerns. If the same forces which were so indefatigable in their efforts for conserving the health and efficiency of the industrial army during the war will only carry over these efforts into the reconstruction period, an entirely new standard of existence will result for the working people of the land, the great army who must produce and provide.

Thus, in the course of one short decade, broad humanizing principles combined with scientific medical and surgical work have permanently established in the medical profession this far-reaching health service—Industrial Medicine and Surgery.

LEAD POISONING IN AMERICAN INDUSTRY*

ALICE HAMILTON, M.D.

Special Investigator, Department of Labor, and Assistant Professor of Industrial Medicine, Harvard Medical School

THE subject of industrial lead poisoning is so large that if it is to be compressed into one lecture it must be limited in some way, and I have decided to take as my field to-day only the contributions which have been made by Americans to the theoretical and practical aspects of industrial plumbism. The foreign literature is easily available to you, while a great deal of the American is tucked away in government reports and rather obscure medical journals. While much that is found in European literature is applicable to American conditions, not all of it is. There are several trades which are notorious sources of lead poisoning in European countries but which here are carried on in a different way and do not give rise to lead poisoning. For instance, cheap tin-

*Cutter Lecture in Preventive Medicine and Hygiene, delivered at the Harvard Medical School, April 2, 1919. Received for publication March 3, 1919.

ware seems to be made in Great Britain and Germany with a lead and tin plating while ours is made either of galvanized iron or of ironware covered with an excessively thin coating of pure tin.

Dyeing and calico printing are always listed among the lead trades in Great Britain, but Edsall (1) found no evidence of lead poisoning from this source in the great textile district of Philadelphia, Kensington. In the Episcopal Hospital in the center of this mill town there had been no case of plumbism in a woman in five years, though thousands of them work in the mills. Among ninety-eight industrial cases in men only one was a weaver and he had probably not contracted the poison from his work. The only case of poisoning from lead-dyed textiles that I have heard of in this country was sent me by Dr. D. J. M. Miller of Atlantic City. He saw a woman with profound neuro-retinitis as one symptom of a bad case of lead poisoning, and her father also had typical lead poisoning though without eye involvement. The woman tore old window shades into strips and wound the rags into balls, and her father wove them into rag rugs.

File making by hand seems to be very common in Europe and the literature on lead palsy is full of descriptions of the peculiar form that is found among file makers. Files in this country are made mostly by machinery, though Hayhurst reports three cases of lead poisoning in file cutters, men who were also doing lead tempering. Diamond polishing is either not carried on to any great extent in this country or is not done in the same way as it is in Holland, for while this is a notorious lead trade in that country, there seems to be but one instance of lead poisoning in a diamond polisher in our literature. E. E. Pratt (2) reports one case discovered during the study made by the New York State Factory Investigation Commission.

There are two great advantages which America has over European countries; we do not employ women in the dangerous lead trades nor do we employ many immature boys and girls. On the other hand, there are several lead industries which are attended with greater danger in this country than in European countries because of American methods.

The following is a very brief statement about the most important lead industries in the United States, with special emphasis on the features peculiar to this country.

Lead mining is carried on chiefly in southeastern Missouri, in Utah, Idaho, and Montana. The Missouri ore is practically pure galena, lead sulphide, but the western ores are nearer the surface and oxidized ores are still mined to a certain extent. These compounds are, of course, more soluble than the sulphide and lead poisoning has always been present in these mines, although as the surface ores become exhausted and the deeper sulphide is mined, it tends to disappear. St. Vincent's Hospital in Leadville has records running back to 1880, and for some time the miners treated in the hospital for lead poisoning numbered about forty to fifty a year, but by 1910 the cases had fallen to eight, and in 1912 there were none at all (3).

Even galena mining is apparently not free from danger. Louis (4) in Oliver's *Dangerous Trades*, says that among 16,827 British lead miners handling sulphide ore only, lead poisoning was practically unknown, only one death having occurred. But one cannot prove the point by saying that there were no deaths. Industrial lead poisoning is seldom fatal. When we were searching in the St. Louis hospitals for cases of lead poisoning from the great smelters nearby, we found records of twenty-five cases which had been treated in the Alexian Brothers Hospital, all of which had come from the lead belt, chiefly from Desloge. They were not from the smelters—there is only one small smelter there—but from the mines and concentrating mills. All were serious enough to require hospital care. One had palsy and another a lead psychosis. These men were handling pure lead sulphide ore and in general this compound has been assumed to be non-poisonous and the statement is commonly made in the literature that this is the one insoluble form of lead. Blum was the chief authority for this assertion and his dictum was generally accepted, though Murgia and Brezina and Eugling got results that pointed to absorption of lead sulphide in the body.

It may be interesting to know that there was a controversy on this subject in 1906 in Milan, at the International Congress of

Industrial Hygiene. Rambousek insisted that lead sulphide was harmless as shown by the fact that there had not been one case of poisoning among 10,000 Bohemian miners. On the other hand, Biondi had seen lead poisoning among the lead miners in Sardinia. The point was finally settled by A. J. Carlson and A. Woelfel (5) of the Physiological Department of the University of Chicago. They tested, with human gastric juice, sulphide ores from the lead belt of Missouri and pure laboratory lead sulphide and found the average percentages of lead dissolved to be, for the pure sulphide, 4.6 per cent.; for the ores from three districts, 1.38 per cent., 2.94 per cent., and 3.32 per cent.

Lead smelting and refining is a very important industry in the United States where much bullion from Mexico is refined in addition to the smelting and refining of our own ores. In 1912, the twenty principal plants employed some 7500 men but this did not include a large smelter on the Pacific coast nor the great number of small refineries working up lead scrap and junk that are to be found in practically every city in the country. The chief centers of the industry are Perth Amboy and Newark, N. J.; Graselli and East Chicago, Ind.; Federal, Granite City, and Collinsville, Ill.; Herculaneum and Joplin, Mo.; Omaha, Neb.; Denver, Leadville, Pueblo and Salida, Col.; Murray, Midvale, and Tooele, Utah; and East Helena, Mont.

American smelting plants are in many respects modern in construction, contain many mechanical devices to do away with hand labor, and an effort has been made in all of them to remove the lead fumes which constitute the great danger in lead smelting. They are, however, far from being model plants though they have improved since 1912 when their rate of lead poisoning was very high. I doubt whether even now any of them would compare with the German smelter I visited in 1912, which was under the direction of a great authority on lead poisoning, Richard Mueller. He had constructed this smelter in such a way as to be able to depend entirely on artificial ventilation, which means that all of the departments, even the tapping floor of the blast furnace, were indoors. Of course, when one or two sides of the building are left open, as is customary in our smelters, the ventilation, or rather the removal of fumes, is at the mercy of wind and weather.

Refineries are probably more productive of lead poisoning than smelters though the heat required in the furnaces is not so great and therefore the fume evil should be less. But refineries work up a great deal of dusty scrap and dross and they are likely to be neglected places, carelessly managed, and cheaply run. The cases of lead poisoning in both branches in 1912 numbered 1667 cases in nineteen plants employing 7400 men, which is a little over twenty-two for every 100 employed. The British rate for that year was only 1.8 per hundred; four German smelters had between 10 and 11 per 100, and one large Austrian plant had 9 per 100 (3).

The metallic lead trades are very extensive, employing large numbers of men and almost all the women who come in contact with lead in industry. There are so many industries in this class that it would be impossible to give anything like a complete list. I have selected those occupations in which industrial lead poisoning has been known to occur in the United States, sometimes in quite serious form:

Lead burning.
Making solder and babbitt.
Soldering.
Making lead pipe, sheet, wire, machine parts, plumbers' goods.
Making shot.
Lead tempering of machine parts.
Making and laying electric cables.
Making leaden trimmings for coffins.
Making leaden picture frames.
Making and using tin foil.
Making car seals and can seals.
Brass founding.
Brass and nickel buffing.
Tinsmithing.
Plumbers' trade.
Typographical trades.

We usually think that handling metallic lead is one of the least dangerous kinds of lead work for the only soluble part of the lead is a fine greyish coating of oxide that forms on the surface and can be rubbed off. Still there are cases on record of lead poisoning following only a short employment in such work. Pratt (2) tells of a twenty-two-year-old man who was poisoned by unloading pig lead from

barges. In a Chicago hospital a man was treated who had for two months swept up the shavings from the casting and finishing machines in a factory where lead fixtures were made. An even more unusual case was found in a Philadelphia hospital. This man suffered with acute lead poisoning after only three weeks' work making lead stoppers and perforated filters for wash basins. Brass filers and polishers not infrequently get lead poisoning from the small amount of lead present in the alloy, this being of course metallic lead, and I have known plumbism in a sorter of lead and brass junk, and in a man who swept up dross from around a kettle and carted it away.

The plumbers' trade is gradually becoming much safer but lead is still used and lead poisoning still occurs among plumbers. Nineteen of the 560 cases found in Illinois were in plumbers. Lead burning is well known to be attended with a great deal of lead poisoning. This is because the lead burner usually has to work inside the receptacle which he is burning. He has to climb into the tank he is lining or put his head into the box. There is another form of so-called lead burning that really should be classed as soldering and that does not require so much skill nor involve nearly as much danger. The men who burn lead connectors in storage battery manufacture use a tiny flame to melt a bar of solder and get very little lead fumes.

Two occupations which do not seem to be conspicuously bad in Europe, judging from the literature, give rise to a great deal of lead poisoning in this country. One of these is soldering cans. This causes an amount of lead poisoning quite disproportioned to its real danger. At present the records of most hospitals in our large cities contain more cases of plumbism among the users of solder and babbitt than among workers in such notoriously dangerous industries as white and red lead, paint grinding and making storage batteries. The Illinois Factory Inspector's Report for the year 1913-1914 contains 184 cases of lead poisoning from four places in which tin cans were soldered. In one crowded workroom with twelve unhooded soldering machines, there were 100 persons employed and here eighteen cases of lead poisoning developed during one month of cold weather when the windows were closed. Another industry in Illinois has a disproportionate amount of lead poisoning. This is the casting and finishing of leaden car seals. There were twenty-eight cases of lead poisoning in a force of 188 employees in Chicago, in one year. E. E. Pratt describes a process which I have never seen mentioned in foreign literature, lead tempering of magnetos, piano wires, and wire cloth. The objects are heated, then plunged into a trough of molten lead, taken out and cooled rapidly, and then rubbed smooth with sand paper. The combination of fumes and dust renders this occupation very dangerous and Pratt found nine cases of lead poisoning in one magneto factory with an average force in that department of only nine men. Kenney (6) of New York describes a case in a temperer of magnetos who was incapacitated after eighteen months' work, with wrist drop, general weakness, colic, anemia, and loss of 50 pounds weight.

The printers' trade needs special mention among those in which metallic lead is used. Probably more study has been devoted to the health of printers in all countries than of any other class of men, for they are decidedly above the average of working men in intelligence and they have not only noted their own high sickness and death rate, but have insisted on finding out the cause of it. You will find very detailed studies of the typographical trades in the literature of Germany, Austria, Holland, and Italy; the English and French are less full. Certain disadvantages in the printers' trade in Europe become evident in these foreign reports, when one compares them with conditions here. There is a very large proportion of youthful workers, especially in Holland. The Germans, Austrians, and French say that the industry attracts the underdeveloped, sickly boys and that printers are far below par physically. Pannwitz found that there was a startlingly small number of printers fit for military service in Germany. In fifty-five districts the average of the physically fit was 427 out of 1000, while the typographical trades had only 238. American printers are certainly not as greatly handicapped as this, though the records of the Prudential Life Insurance Company show that

they average a little lower in inches and a little lighter in pounds. The figures are: 149 pounds for printers, 157 pounds for occupied males; 67.7 inches for printers, 68.1 inches for occupied males.

The Typographical Union has interesting records of the mortality of American printers from tuberculosis and the so-called degenerative diseases, but little or no information as to lead poisoning. To throw light on its prevalence an examination of 100 printers was made in Chicago by Dr. J. D. Ellis, and a similar examination by Dr. Walter W. Palmer in Boston. They found eighteen cases of plumbism among these 200 men, or 9 per cent. However, only ninety-three, 46.5 per cent., were found to be free from noteworthy symptoms of ill health; the remaining 107 had health more or less impaired. The significant symptoms were abdominal pain, constipation, articular pains and headache (7).

Conditions in the printing trades have improved greatly of late years and are now, on the whole, fair, sometimes excellent. The model printing establishment, however, in my experience, is still the Royal Printing Shop at The Hague, where the bright red tiles of the floor are kept free from any particles of lead, the benches are spotless and all lead pots are hooded.

The manufacture of white lead has been regarded in every land as one of the most dangerous of the lead trades, if not the most dangerous. In the United States it was even more dangerous than in Europe. In the making of white lead, dust is the great danger and our methods are much dustier than those of England or Germany. I am sure you are familiar with the Old Dutch process of making white lead. This same process is used in England, Germany, and Belgium, but it is only in Belgium that the corroded lead is separated from the uncorroded remnants by a dry process as it is here. In England and in Germany the pots of corroded lead must not even be emptied till the whole has been sprinkled with water to keep down the dust; then the corroded lead is thrown into tanks of running water and the white lead is washed off and flows along leaving the uncorroded cores of metallic lead behind. In our white-lead works, the pots must be emptied without sprinkling and the corroded lead is carried to a dry separator from which the white-lead powder and cores are discharged in a dry state. Obviously there is a great deal more danger in this way of handling white lead.

Another feature peculiar to the American white-lead industry is the Carter process of corrosion. This is a quick corrosion of lead which has been atomized to the finest powder so that acetic acid can act rapidly upon it. The disadvantage of the method is that it involves the handling of powder throughout. The advantage is that it is largely mechanical, requiring little handwork.

Since 1910, when this industry was investigated, very far-reaching improvements have been made, especially in the white-lead branch and the rate of poisoning, which then was 388 cases in sixteen months in a force of 1600 men, is now very much lower (8). The centers for the manufacture of red and white lead are: Brooklyn, Perth Amboy, Philadelphia (the largest), the region near Pittsburgh, Cincinnati, Detroit, St. Louis, Chicago, Joplin, Omaha, and Selby, Cal. In one plant only, the one at Joplin, roasting oxides is carried on in connection with lead smelting as it is in Europe. Our usual way is to combine oxide roasting with corrosion of white lead.

Lead poisoning in potteries and tile works was notorious for years in England and Germany, and in both countries, especially the former, great efforts have been made to protect potters and tile workers against the lead used in glazing and decorating. The results have been quite wonderful and English potteries are, on the whole, the most remarkable instances of factory sanitation I have ever seen. Aside from the precautions taken to avoid dust and other dangers, the English make an effort to render the lead in their glazes insoluble by fritting it; that is, by fusing it with the other constituents and thus changing the soluble white lead, or the lead oxide, in part, to the insoluble disilicate. This is not done in our potteries. The glaze is fritted but most or all of the lead is added after the fritting. Unfortunately this far more poisonous American glaze is used in potteries which do not in any respect bear comparison with British and German potteries and there is much more lead poisoning among the men and women

potters in America than in Europe, just ten times as much among a group of men dippers in Ohio as among the dippers in North Staffordshire. The chief centers of these industries in this country are Trenton, the East Liverpool region and the region around Zanesville, both in Ohio (9).

Enamelling sanitary ware is a much more important industry with us than with Europeans. We build more new houses and we put a great many more enamelled bath tubs and sinks into those houses. But the fact that this is such an important industry in America has not led us to take better care of the workmen than the English and the Germans do of their far smaller number. Quite the contrary is true. The great majority of British and German enamelware factories use a leadless enamel and in Germany the enamel is applied with water. Only in Austria is enamelling done as it is here with a dry glaze, rich in red lead, applied in powder form over red-hot ware. In Austria this is known to be a very dangerous lead trade. Our enamellers and enamel grinders work in an atmosphere thick with glaze dust that contains from 2.5 to 20.4 per cent. of soluble lead. It is one of our very worst lead trades.

In enamelling sanitary ware and sinks the rate of plumbism in 1911 among something over 1000 men was 21.4 per cent., but an examination of 148 men out on strike showed that 36 per cent. were affected by the lead. Whether or not the industry has improved of late years I do not know. The largest center for this manufacture is Pittsburgh, with three neighboring towns, and there are also plants in Trenton, Louisville, Chicago, Chattanooga, and Sheboygan, Wisconsin.

For many years there has been an agitation in Europe in favor of the substitution of zinc white for white lead in paints because of the recognized danger of white-lead paint. No country has gone so far as to prohibit altogether the use of lead paints except France, in which country the law prohibiting the manufacture or importation of white lead and of white-lead paint was intended to come into force January 1, 1915, but probably the war postponed this date. In Germany the law protects the painter against lead dust by forbidding him to mix white lead by hand or to use dry rubbing down for painted surfaces. It also requires the contractor to make very generous provision for the cleanliness of the painters. In Belgium, dry rubbing of lead paint is forbidden, and washing facilities and lunchrooms required. These same features are covered by the Austrian law, which also requires the labeling of paints to show which contain lead, and discourages the use of lead paints for interior work. Scandinavian and Swiss painters tell us that in their home countries zinc white is used for interior work far more than it is here in America, and it is customary to dip sand paper in oil before using it to rub down. Evidently then there is more risk of lead poisoning for American painters than for European.

The most dangerous branches of the painters' trade in this country are ship painting, interior decorating, especially expensive work—for cheap houses are likely to be painted with quick drying leadless paints—and certain departments of carriage and automobile painting. All these require rubbing down and exposure to fine lead dust. There used to be a great deal of poisoning among men who painted the interior of Pullman cars, but now a sublimed lead paint is used, which is less poisonous than white lead.

Painting is, of course, the most notorious of the lead trades and in almost every hospital and dispensary painters make up the large majority of the cases of lead poisoning. This is partly because every community has some painters and may have no other lead workers, partly because it is a skilled trade and men do not drop out if they can help it, and partly because lead poisoning in a painter is more likely to be recognized by the physician than is the case with other lead workers. Of sixty deaths from plumbism in New York State, reported in 1910 by Andrews, 75 per cent. were painters. Thirty-eight per cent. of the 109 serious cases described by Pratt in New York City in 1911 were painters, and 26 per cent. of the 578 cases of plumbism found in Illinois in 1908-1910. These figures show that if you take all the cases of plumbism in a community you get a large proportion of painters among them; if you pick out the most serious cases, the proportion increases; while if you take the deaths only, the proportion of painters becomes enormous.

The form lead poisoning takes in painters is consequently very severe. Of 100 lead-poisoned painters in the County Hospital in Chicago, two-thirds had had more than one attack and only one-third had the pure gastric form of plumbism without complications. There were 39 cases of palsy, 6 of acute encephalopathy and 3 of slow mental deterioration, 11 of disturbed vision, 24 with arthralgia, and 8 with arteriosclerosis of marked degree.

Several interesting studies have been made of groups of painters in this country. Hayhurst (10) examined 100 working painters in Chicago in 1913. He did not find any with acute symptoms of lead, but indications of chronic plumbism were found in seventy cases. In 1915 Apfelbach and Gibson of the State Factory Inspection Department of Illinois examined 150 painters and noted that twenty-three had a history of lead colic, while diseases in which lead may have had a part were found as follows: 22 nephritis, 49 hypertrophied heart, 9 of them with valvular disease, 26 active tuberculosis, and 10 with latent tuberculosis. In 1918 Harris of the Occupational Disease Clinic of New York City Health Department, published the results of an examination of 304 painters, 162 of whom, or 53 per cent., had symptoms of plumbism and seventy-five gave definite reaction for lead in the urine.

Another American contribution to the study of the painters' trade was made by Dr. A. J. Carlson (11) on the comparative solubility of white lead (basic carbonate) and lead sulphate, called in the trade, sublimed lead. The controversy that led up to this investigation was not scientific but commercial, the Pullman Company having announced its intention of substituting lead sulphate for white lead and giving as one reason the non-poisonous qualities of the former. Very extravagant claims as to the safety of sublimed lead paint were made by the manufacturers both here and in England and it seemed necessary to put them to the test. Using the human gastric juice, of which Dr. Carlson has a never-failing supply from a man with gastric fistula, he found that lead sulphate, if dissolved in gastric juice is soluble to the extent of 24.7 to 30 per cent., while the basic carbonate is soluble to the extent of 59.8 to 77.9 per cent. This shows that though lead sulphate paint is less harmful than white-lead paint, it is far from being harmless.

Storage battery manufacture is carried on in six large plants in this country, in Philadelphia, Niagara Falls, Depew, N. Y., Cleveland, and Indianapolis. They were investigated in 1914 and again in 1918, and not nearly as much improvement had been made in those four years as one would expect. As carried on in this country storage battery manufacture is a very dangerous lead trade, having in 1914 a plumbism rate of 17.9 per cent. while Great Britain's rate was 2 per cent. in 1912 and the largest plant in Germany had 0.97 per cent. Only one of our plants is scrupulously clean and carefully managed, though three more are fair (12).

The use of lead in the rubber industry must be mentioned, though this is not really a lead trade, only a few rubber workers being exposed to lead. Litharge and lead sulphate are the salts used in compounding, rarely white lead. Most of the information on lead poisoning in the rubber industry comes from Ohio and Massachusetts, but New Jersey is also a very important rubber state. The dangers are easily controllable and although lead poisoning is not at all notorious in rubber works, still it is surprisingly common in some plants. In one, employing 1200 persons, only twenty-five handle lead, but there were in one year four cases in the compounding room and seven at the mixing mills. Another large factory with forty-four men compounding and bolting, had fifteen cases in one year (13). Among 162 cases of lead poisoning in the Massachusetts General Hospital, eighteen or 11 per cent. were rubber workers.

It would be impossible to give a list of all the occupations in which lead constitutes a hazard in American industry. W. Gilman Thompson gives eighty-five and several of them are not occupations but trades with several processes, differing much in danger. Hayhurst points out the importance of specifying not only the trade, but also the process in which the worker is engaged. He has found lead poisoning in an oil refinery, from handling lead pipe; in making scientific instruments, from grinding and soldering parts; in making emery wheels, from the use of babbitt.

These are a few of the more unusual sources of lead poisoning gathered from the lists of Thompson (14), Kenney (6) in New York, Hayhurst (15) in Ohio, and the Illinois Occupational Disease Survey: using white lead in white felt hat manufacture; drawing bristles through the pads of brushes, which have been painted with white lead; stenciling patterns with white lead; lineoleum manufacture, litharge being added as a drier to boiling oil and lead colors being applied; carrying leaded torpedoes in the same pocket with chewing tobacco; tempering parts for cash register machines; polishing cut glass with putty powder; zinc smelting; making artificial flowers; making and selling wall paper; making sodium acetate from the wash water from white-lead works; placing enamelled letters on windows with a white-lead paste.

PORTAL OF ENTRANCE FOR LEAD

Of the three portals of entry, the skin is probably negligible if we are considering industrial poisoning only. At least that is the opinion of the best British and German authorities and I have found nothing in American literature to contradict it. The intestinal tract is by far the most important but this does not mean that most cases of lead poisoning are caused by eating food or chewing tobacco that has been contaminated with lead. The breathing in of lead dust and fumes is by far the most frequent cause of lead poisoning, but most of the lead that is breathed in is not absorbed through the lungs but through the intestinal tract. K. B. Lehmann's assistants, especially Saito (16), have shown that when dust is inspired, less than one-quarter reaches the lungs; the remainder is caught in the mucus and saliva and is swallowed. So the mechanism of poisoning from fumes and dust is practically the same as that from eating soiled food, and it is incomparably more frequent.

Perhaps the most common superstition with regard to industrial plumbism is this, that the lead worker poisons himself by neglecting to wash his hands and scrub his nails before he handles his food. Certainly this is a possible source of poisoning, but any one who stops to think for a moment can see that it could rarely give rise to anything but a slow and gradual form of plumbism. Richard Mueller, the head of a model lead smelter in Germany, succeeded in estimating the amount of lead which a man might breathe in and compared it with the amount that could be washed off his hands at the end of a day's work. He found that a blast furnace tapper could breathe as much as 1.0625 gm. in the course of a ten-hour day, but that it was possible to wash off his hands only 0.0876 gm. (17). Obviously unless a worker literally washed his hands in his soup or coffee, he could not get even all of that into his mouth.

Even if the man works with large quantities of fairly soluble salts of lead, I doubt if the danger of his getting the lead into his mouth from his fingers is as great as the danger of breathing lead dust. Occasionally one does come across a case of real finger poisoning. In the Cook County Hospital a Bulgarian was treated for acute lead poisoning which, he said, he had contracted while pasting plates with litharge paste in a storage battery plant. He did not know there was any harm in the mixture and so he used to moisten his fingers in his mouth. He was seriously sick at the end of ten days. Another occupation in which poisoning takes place by direct ingestion of the lead is the work of commercial artists, mechanical re-touchers, who touch up the photographs for catalogues and advertisements with white paint in order to bring out the high lights. They often put their little paint brushes in their mouths and as they almost invariably use white-lead paint, serious forms of poisoning are found among them. We discovered fifteen cases in Chicago in 1909.

But such instances are exceptional. As a general thing a man does not put his fingers in his mouth, he eats only three times a day, but he breathes all the time. A few years ago I had an opportunity to compare two typical lead trades, one wet and one dusty. Eighty-six white-ware dippers worked with their hands and arms covered with a liquid glaze that contained from 10 to 20 per cent of soluble lead. One hundred and forty-eight sanitary ware enamellers scattered a finely ground enamel over heated iron ware, the dust containing only 2.5 to 9 per cent. soluble lead. One dipper in every six to seven had lead poisoning, but one enameller in every two to three (9).

It has seemed important to lay stress on this point because it is one on which industrial physicians are so very likely to be at fault. I remember a physician in charge of a large smelter who told me that the lead poisoning among the men was attributable to their dirty habits and that he was continually urging them to scrub their nails. I had just been out to the smelter and had seen the discharging of a great Huntington-Heberlein pot containing tons of roasted ore, red-hot and fuming. It fell with a great crash on the grating of the dump and when the clouds of dust and smoke cleared away a little, I could see the men chopping the bigger blocks and pushing them through the grating. These were the men who had been urged to protect themselves by scrubbing their nails.

In another large smelter the very dangerous open-hearth method was used and lead poisoning was so frequent and so bad that the company resolved to spare no expense to get rid of it. Following the advice of their physician they put up an excellent bath house and provided soap and towels, but they did nothing about the fumes at the hearths. When I made a second visit more than a year after, I found them much discouraged because lead poisoning was about as bad as ever. Of course I do not mean that personal cleanliness is not important. It is, but not nearly as important as cleanliness of the work place. The rule should be to give the men plenty of opportunity to get clean at the end of the day's work, but to devote most of the available time and money to the control of dust and fumes in the work rooms.

INDIVIDUAL SUSCEPTIBILITY

Everyone in the lead trades knows that there are men who can hardly stand any exposure to lead, while others can handle it for years with apparent impunity. Hirt tells us that from 20 to 30 per cent. of all lead workers are not susceptible to lead and that of the remaining 70 to 80 per cent., something over one-half become poisoned very quickly, the others more slowly. The only accurate figures I was ever able to obtain on this point in an American lead trade showed a smaller proportion of men immune to lead than that given by Hirt. There were two very dangerous white-lead factories which I visited in 1911 and in which every man was examined by a physician at least once a fortnight. The records showed that 35 per cent. of all the men in one factory and 28 per cent. of all in the other were suffering from the effects of lead. But, omitting the newer employees and taking only those who had been employed as long as one year, we found that the rates were 52 and 40 per cent. Only 10 per cent. in one factory and 12 per cent. in the other had been able to resist the effects of the lead for as much as eight years (8).

A few years ago a study of any lead industry in the United States seemed to reveal a large number of over-susceptible men who developed serious symptoms after a short exposure, but it is important for us to distinguish between those who sicken quickly because of an enormous dose of lead and those who respond over-quickly to ordinary exposure. There used to be many cases of the first class in American industry; there still are more cases than we like to think.

An early article on lead poisoning in the white-lead industry in the United States shows that rapid and severe poisoning used to be quite common. Hobbs (18) of Omaha published an article in 1898 based on his experience with a very dusty plant. He had seen twenty-six cases develop after an exposure of two weeks to six months. Some twelve years later this same industry still had a large proportion of rapidly developing cases. Among 120 white-lead workers with acute plumbism, one-half had sickened in less than two months and 68 per cent. in less than six months. These figures are too large to be explained on the ground of individual susceptibility; they mean excessive exposure. The over-susceptible are probably represented by the 6.6 per cent. who became poisoned in less than two weeks, one of them after three days.

The smelting and refining of lead, especially in certain plants, is a very dangerous trade. In 1912, among 167 men with plumbism, no less than 72 per cent. had succumbed after an exposure of less than six months. Here the over-susceptible were the thirty-seven who were poisoned after less than eight weeks' work. That excessively bad conditions in this industry can bring about even more rapid poisoning

is shown by Hall's (19) report of the American Smelting & Refining Co.'s plant at Aguas-Calientes, Mexico. He states that the flue dust men in this plant sometimes develop acute symptoms after seventy-two hours' work and that usually it takes only eight to ten days to incapacitate them. Painters do not often acquire plumbism quickly, but among 100 with lead poisoning in the Cook County Hospital were twelve who came down with it in less than a year's time.

Over-susceptibility is shown not only by the rapid onset, but by the severity of the symptoms. Pratt (2) describes a very severe case of lead poisoning in a printer which must certainly be regarded as an instance of unusual susceptibility because the exposure to lead in the printing trade is so slight. This was a young man of 22 years who had worked for nine years as a compositor and make-up man. He had never been ill in his life before he was taken with acute lead poisoning and died on the fifth day.

The case reported by C. Williams (20) also is one of over-susceptibility. A man who had been teamster in the yard of a lead works was transferred to indoor work where he was exposed to fumes. After five weeks he was sent to the Philadelphia Hospital with acute plumbism, remained there a month and was then discharged cured. He went back to work, but two months later was re-admitted to the hospital and was under treatment for six months. Again he was discharged, but a month later was re-admitted to the insane ward, where he remained for seven months with toxic confusional insanity due to lead. When Dr. Williams saw him seven months afterward he had partial palsy of the arms, muscular tremors of arms, hands, and lips, hesitating speech, and left lateral homonymous hemianopsia.

This great variation in susceptibility often leads employers to argue that they cannot be held responsible for cases of lead poisoning that occur in their works because, if there were really any danger present, all the men would suffer. If they can produce, as they always can, a few elderly men who have worked in lead for years and never had colic or palsy, they believe they have proved their point, but no one would use an argument of this sort about an infectious disease. We all know that there is the widest difference in natural immunity and natural susceptibility to the different infections. You cannot prove that typhoid infected water is not dangerous by pointing to people who went through an epidemic without getting typhoid fever, nor can you prove the uselessness of vaccination by pointing to a few unvaccinated who do not take smallpox.

RACE SUSCEPTIBILITY

There is a general impression among lead men that negroes are more susceptible to lead poisoning than white men. So far as I know this has never been confirmed. It remains an impression. Edsall (21) in his article in Osler's *System of Medicine* quoted Monell, a smelting expert, as saying that negroes are especially prone to lead convulsions. Edsall found that, of six cases of plumbism among negroes in a Philadelphia hospital, three were encephalopathies. There are only two trades in which I have found negroes employed along with white men so that the effect of lead on the two races could be compared and, though I could not find that lead poisoning was more frequent among negroes, I did find a greater proportion of encephalopathy in those who became poisoned. In the white-lead industry only 15 per cent. of the employees were negroes, but four out of nine cases of lead convulsions or delirium were in negroes. Negroes were employed in a smelter where fumes and dust were unusually bad. Taking only the men employed in the worst kinds of work, it was found that eighty-four white men had four cases of encephalopathy, making about 4.7 per cent., and seventy-five negroes had fifteen cases, or 20 per cent.

SEX SUSCEPTIBILITY

The English authorities, Oliver, Legge and Goadby believe that women are at once more liable to lead poisoning than men and more subject to the severer forms. Thus Oliver (22) says that during the six months of 1898, before the law forbidding the employment of women in work with white lead went into effect, there were 350 women employed in such work in Newcastle-on-Tyne and there had been sixty-six cases of lead poisoning among them with four deaths, while the 648 men had had but nineteen cases with one death. It

is evident, however, that the women were doing the very dangerous work of stripping the white stacks and emptying the stoves. In the following six months these women were displaced by men and the men's cases rose to eighty-two.

Arlidge (23) does not believe that women are more susceptible than men. His observations were made in the North Staffordshire potteries. In the hospital there, in what they call the ambulant department, 463 men were treated, 8 per cent. of whom had lead poisoning, and 337 women, 5.05 per cent. of whom had lead poisoning. Yet women did much of the dipping in the potteries and most of the majolica decorating. The Germans do not believe that women are more susceptible than men. Agnes Bluhm (24), writing in Weyl's *Handbuch der Hygiene*, says that if a larger number of women become poisoned, "it is because women usually make much lower wages than men and are less well-nourished and, since they often have to do housework in addition to their factory work, they are more overworked than men." If women work in lead dust they are more likely to carry it home on their clothes and hair than men are.

Our information on the effect of lead on women in America is fortunately very scanty, for we have never employed women in any of the more dangerous lead processes with the exception of lithotransfer work and the finishing of glazed pottery and tiles. Industrial lead poisoning in women is still a rarity in the United States. Of the 268 cases which W. Gilman Thompson has seen in New York only one was a woman. Edsall saw ninety-eight cases in the Episcopal Hospital in Philadelphia, all men. E. E. Pratt gives the details of 109 serious cases of plumbism, two of which were in women. Among the 578 cases listed in the report of the Illinois Occupational Disease Commission, there were only eighteen women. Chicago has four lead trades that employ women in fairly large numbers, the making of lithotransfer papers, soldering tin cans, casting car seals, and founding type.

It is very difficult, then, to compare the susceptibility of men and women to lead in American industry. Lithotransfer work, dusting finely ground lead colors over specially prepared paper, has always been productive of lead poisoning in a considerable proportion of the girls who do the work. But no men are employed here so the figures from this trade are useless for our purpose. In type founding we have not accurate enough figures, nor have we in connection with the use of solder. It is only in the glazing of pottery and tiles that it is possible to make a comparison, and there the figures seem at first to bear out the English theory. In the New Jersey and Ohio potteries there were, in 1911, fifty-seven cases of lead poisoning among 400 women who were exposed to lead, or one in seven, and only eighty-seven among 1100 men, or one in twelve or thirteen. But other factors must be considered before these figures can be taken to show sex susceptibility. There are two distinct branches in the pottery industry in this country; first, the white-ware potteries in which the men are strongly organized and get high wages, but the women do not belong to the union and get poor wages; and second, the art ware and tile works in which there is no organization and both men and women work for low wages. The women in the white-ware potteries had one case of plumbism to every five or six employed; the men only one to every twenty or twenty-one. But in the unorganized potteries and in the tile works where men and women are in the same economic class, all making low wages, there is no such contrast between the two sexes. In 1911 the men had one case of lead poisoning for every six to seven employed, the women one to every eight or nine. The slightly greater incidence among the men was probably to be explained by longer employment, for the women dropped out of the industry at an earlier age than the men did (9).

These figures are too small to be of much real significance and the same thing is true of the statistics on encephalopathy among women. All authorities say that women are more liable to acute cerebral lead poisoning than men and this proved to be true in American potteries and tile works. Among 1100 men there were 87 cases of plumbism with 3 encephalopathies, among 400 women, 57 cases with 13 encephalopathies. Or to put it in another way, the rate of plumbism among men was about 8 per cent., but of these only one in seventeen had the brain form. The rate among women was 14 per cent., but of these one

in four or five had encephalopathy.

The important feature of lead poisoning in women is not their own greater susceptibility to the poison, but the fact that it acts on the generative organs, or rather upon the products of conception, making women sterile, or incapable of carrying a child to term, or of bearing a healthy child. Now these conclusions are not based on any American statistics, for we are fortunate in having none. Married women have not been employed in the lead trades in this country in numbers large enough for us to know what effect lead has on their childbearing powers. But the statistics from England and France are striking enough to leave no doubt as to this effect.

As for the effect on the offspring of lead poisoning in the father, we find very little that is convincing in the literature. Indeed it is a matter of surprise that most of the text books on industrial diseases should speak as positively as they do on this subject since, except for some scanty figures from France, there is almost nothing definite as to human beings. However, two interesting experimental studies bearing on the subject have been carried on in American universities which show that in the lower animals lead poisoning in the father has a decided effect on the nutrition and viability of the offspring. Cole and Bachhuber (25), working at the Wisconsin Agricultural Station, administered lead acetate to rabbits and fowls. In the case of the rabbits the mortality of the young during the first four days after birth was 47.7 per cent. when the father was leaded, as contrasted with 29.2 per cent. when the father was normal. The average weight at birth was 49.8 gm. for the former, 59 gm. for the latter.

C. V. Weller (26) of the University of Michigan used commercial white lead in capsules for feeding guinea pigs. The experiments with leaded males gave very interesting results.

	Free Female Free Male	Mated with Leaded Male
Number of offspring...	58	65
Average birth weight in grams...........	81.5	66.3
Number stillborn......	3	3
Died first week.......	2	9

A normal female was mated alternately with a normal and with a leaded male. The resulting offspring weighed 79 gm. when the male was normal; 54, 47 and 40 gm., when the male was leaded. This underweight was found to persist through life. There was also a high rate of mortality during the first few days after birth. Nine out of sixty-five offspring of leaded males died during the first week, but only two out of 105 offspring of control males.

As for lead poisoning in children, this is not usually an industrial problem. Fortunately it is very rare to find even fourteen-year-old boys or girls in a lead trade in this country. There are three curious instances of widespread community poisoning from lead industry, including children and non-employed women. One is the poisoning that occurred around the mine and smelter at Broken Hill, Australia (27), where fumes were spread over the countryside, causing plumbism in many of the inhabitants. Another is the family poisoning in certain Hungarian villages where pottery glazing is a home industry (28). The third is to be found in Mexico, but as the company operating the smelter is American and the physician reporting the conditions is also American, we may perhaps count this as an American plant. The instance in question is the wholesale poisoning of the men, women and children in Aguas-Calientes, Mexico, by the fumes from the smelter of the American Smelting & Refining Co. The report describing this last is one of the most extraordinary I have ever read, but as it is tucked away in the pages of a local journal, the *Texas State Journal of Medicine*, it seems to have escaped general attention, as it escaped mine until recently. The author, Dr. H. C. Hall (19), is apparently quite unconscious of the shocking nature of the conditions he is describing and therefore tells us with the utmost frankness of the effects of lead, not only on boys from 10 years up who apparently are employed in the smelter and who get palsy of the legs, but also on the women and babies living in the company houses close enough to the smelter to be poisoned by the fumes. He finds that lactation is affected in these women. Some 22 per cent. of the mothers were unable to nurse their babies satisfactorily. Forty per cent. of these were primiparæ, but 30 per cent. were multiparæ, who had been

able to nurse the babies born before they came to the smelting village to live. He also found that parturition was rendered difficult by uterine inertia, which is rare usually among Indian women, but was present in 21 per cent. of those confined at the smelter. Dr. Hall had the curiosity to test a number of placentas for lead, reducing them first to ash. He does not give us the number examined, but says that he found lead in every instance. He also examined the blood and scrapings from uterine curettements which were done for dysmenorrhœa and found lead every time. No less than 80 per cent. of the babies born in this village had delayed dentition, the first tooth appearing sometimes as late as the thirtieth month. Children who had come to the village with old mastoid infections suffered relapse, little girls had a non-infectious vaginal discharge, latent malaria and rheumatism became active again.

The description of lead and arsenical poisoning among the men in the smelter is sufficiently shocking, but the wholesale family poisoning which apparently went on unchecked, almost taxes one's credulity. Judging from this article the company contented itself with urging personal cleanliness on the families of the employees.

LEAD PALSY

The theory that is generally accepted now to explain the localization of lead palsy is Edinger's *Aufbrauchtheorie* or exhaustion theory, namely, that fatigue is the main factor in the localization of lead palsies. We no longer say that the poison has a predilection for any group of muscles; the group that becomes palsied is the group that has been overused. Mellon (29) of the University of Michigan has confirmed Edinger's theory experimentally on frogs and there are plenty of instances in the American literature of industrial poisoning that bear out the theory. Hall of Aguas-Calientes describes fifty-five cases of palsy in a lead smelter. Only five of these had the typical lead palsy, wrist drop, and these men were all blast furnace tappers. Twelve men had foot drop, five had palsy of the deltoid muscle only, and thirty had the Duchenne-Erb type involving deltoid, biceps and brachialis anticus, three had palsy of the supra- and infra-spinati. In Pratt's group of thirty-six painters, thirteen had palsy involving wrists, or fingers, or arms, or all of these. One had palsy of the legs also. In his white-lead cases, however, while five had wrist drop, four had other forms of palsy, and the same was true of two out of seven solderers.*

Among twenty-two cases of palsy in white-lead workers in 1910, only five had palsy of the wrists alone, thirteen had loss of power in legs and wrists both, and four in the legs alone. These men were unskilled laborers making coarse movements, lifting heavy pots, shoveling and trucking. A clear instance of the exhaustion theory was related to me by Dr. A. J. Boucek of Pittsburgh. A man had been employed for ten years filling wooden kegs with white-lead paint and had never shown any symptoms of lead poisoning. Then the company he worked for began to use small iron pails instead of kegs. The patient had always held the barrel shaped kegs with his hands placed flat against the sides just below the bulge, but the iron pails had smoothly slanting sides and he was obliged to grasp them by crooking the ends of his fingers over the projecting bottom edge. He found the work far more tiring than his old work had been, and after a few weeks a double wrist palsy developed that lasted many months. In this connection I might mention the statement made to me by an observant manager of a white- and red-lead works who was trying to convince me that lead poisoning took place through the skin. He said: "I have noticed that men who work in the lead with their hands get wrist drop, those who carry loads on their shoulders get palsy of the shoulders, and the truckers who pass to and fro over the dusty floor barefoot or with worn out shoes get the ankle drop."

The fact that an injury may determine the localization of a lead palsy does not militate against Edinger's theory, rather it confirms it. Walsh (30) in 1908 reported a case of wrist drop in a painter coming on within twenty-four hours after he had sprained his wrist.

There is space for only one or two more American contributions to our knowl-

*In his diagram Pratt gives fifteen cases of palsy in painters, only five of them affecting the wrists, ten affecting other parts of the body. But a careful reading of the histories of his thirty-six painters gives the above result

edge of the lead trades. One has served to clear up the question of danger from fumes of molten lead in the printing trade. This was a subject of dispute and the statements in the foreign literature were far from conclusive. Linotypists in this country were insistent that lead fumes from the pots of linotype machines were responsible for their ill health and asked for laws to require the removal of the fumes. Dr. Earle B. Phelps (7) of the Hygienic Laboratory of the Public Health Service has settled this doubtful point for always. Believing that the contradictory results obtained by different experimenters might be due to the fact that lead when stirred or skimmed or ladled gives off fumes at a temperature at which lead at rest may not give off enough to be recognizable, he reproduced in the laboratory the conditions present in linotyping, monotyping, stereotyping and electrotyping, and found that while in stereotyping and electrotyping the temperature may be high enough to give rise to fumes when the lead is agitated, in linotyping and monotyping there is neither enough agitation nor a high enough temperature to allow of the escape of lead fumes. The discomfort complained of by linotypists when working at machines with no provision for carrying off fumes is to be explained by the fumes from the gas used to keep the lead hot.

There are many interesting individual cases of lead poisoning reported in our literature, but I have space for only one: It was reported by E. W. Larzell (32) of Colorado. A man who was foreman in a sheet lead works had an attack of lead poisoning so severe that he almost died and had to give up his position and go into lead-free work. Sixteen years later he had pneumonia and as resolution was slow and incomplete his physician put him on iodide treatment. The result was a typical ankle drop, the solvent action of the iodide having liberated the lead which all those years had remained stored in his tissues.

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THE PROBLEM OF FATIGUE*

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CONTENTS

INTRODUCTION

EVEN an approximately complete discussion of the problem of fatigue would require many hundred printed pages. In the first and theoretical part of the following paper we, therefore, propose to limit our discussion to certain important chemical and physiological aspects of the problem of fatigue in the human organism. We shall make no attempt to review all the experimental work upon this phase of the subject, but shall confine our attention chiefly to certain important contributions that have appeared for the most part since 1903 (Note 1). We shall then proceed (Part II) to review the results of the practical application of scientific and experimental methods to the problem of fatigue in industry. Finally (Part III), we include a bibliography which is necessarily incomplete but which will serve as a working basis for further study.

PART I: THEORETICAL

1. *Fatigue in terms of chemical equilibrium.*

If some mechanical genius should announce to the scientific world that he had devised a gas engine which, while standing still, could replace the wear and tear on cylinders and bearings and pistons, we should hail the discovery as revolutionary. Man-made machines are not of this type but nature's machines, which we call organisms, have precisely this extraordinary power of recuperation. The entire process of power consumption and energy interchange in organisms we term metabolism, and metabolism has both its constructive (anabolic) and its destructive (katabolic) phases. The two processes of metabolism are interrelated in such a way that they constantly tend to balance each other. Physiologists, therefore, speak of a "metabolic equilibrium." The conception of organisms as complex, physico-chemical systems constantly striving toward equilibrium is fundamental for the understanding of any physiological process. For convenience we may borrow from the chemists a scheme to represent the two phases of metabolism in equilibrium.

$$\text{Energy at High Potential} \underset{\text{Anabolism}}{\overset{\text{Katabolism}}{\rightleftarrows}} \text{Energy at Low Potential}$$

The two arrows indicate that neither anabolism nor katabolism is ever present alone but that, once the degradation of energy has begun, a reaction in the opposite direction—a tendency to deposit energy at high potential—is developed. Furthermore, both the degradation and accumulation of energy are limited. Now, whereas broadly speaking the truth of our schematic presentation holds for all so-called "vital processes," we are for the moment particularly interested in the problem of the energy exchanges and activities of muscles and nerves.

It is common knowledge that muscular work can not be continued indefinitely; after a longer or shorter time we must

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rest, but, after a longer or shorter period of rest, we find that our energy has returned to its former high level or potential. With these facts fitted into our equilibrium scheme, the relation between work and rest may be written:

Energy at	Work	Energy at
	⇄	
High Potential	Rest	Low Potential

In chemical terms, the *work reaction* reduces some of the total available energy to low potential; the *rest reaction* restores energy to high potential. The rest reaction is thus seen to be an active, synthetic process.

The chemists are familiar with an enormous number of simple reactions which show this type of reversible equilibrium. A standard illustration will help to throw further light upon the $\frac{\text{work}}{\text{rest}}$ equilibrium. If water is added to ethyl acetate, alcohol and acetic acid result (Note 2). The reaction is written:

$$\underset{\text{ethyl acetate}}{C_2H_5COO\ CH_3} + H_2O \rightleftharpoons \underset{\text{ethyl alcohol}}{C_2H_5OH} + \underset{\text{Acetic acid.}}{CH_3COOH}$$

Alcohol and acetic acid are at first formed very rapidly but gradually there develops a greater and greater tendency for alcohol and acid to re-form water and acetate (Fig. 1). A reaction running from right to left is set up and runs concurrently with the reaction from left to right. Finally the reactions proceed with equal rapidity in both directions and are said to be in *dynamic equilibrium.* Considering for a moment only the acetic acid, we may say that after a small amount of acid has been formed, further accumulation of acid slows down the reaction more and more until we finally reach a point where the reaction is limited by one of its own products (Fig. 1).

Turning now to the simple case of an excised frog's muscle, we find that one important reason why we cannot make this muscle raise a given weight indefinitely, why the work reaction cannot continue until all the energy at high potential is consumed, is because of the gradual accumulation of an acid (in this case, lactic acid) (Note 3). The work reaction is thus gradually limited and regulated by one of its own products. If, instead of allowing the lactic acid to accumulate, we remove it either mechanically by washing it away, or chemically by oxidation or neutralization, we find that the work reaction continues much longer.

During and following human muscular activity, the mechanical removal of lactic acid and certain other products of muscular work is accomplished in part by the irrigation of the circulation. The blood likewise deposits sugar in the muscles, thus constantly replenishing the source of high potential energy. Now it is possible for a muscle to work at such a rate that the removal of acid is exactly as rapid as the deposit of sugar. The muscle is then in the condition of dynamic equilibrium. Such a muscle may continue to work almost indefinitely as in the case of the beating heart (Fig. 3).

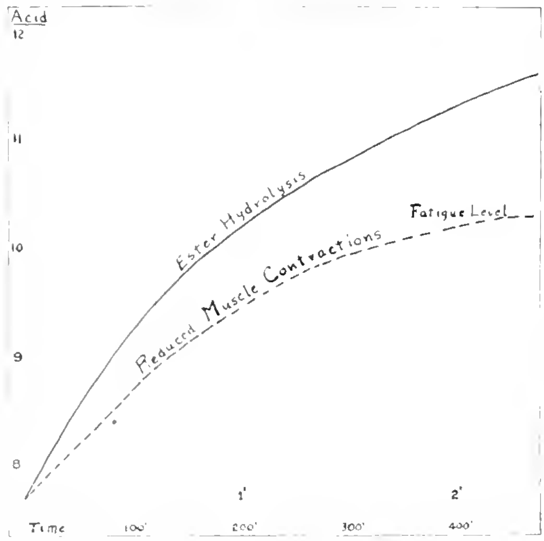

FIG. 1.—Curves showing a self-limited reaction in a simple and a complex organic system. The upper curve shows the course of ethyl ester hydrolysis during a period of more than six hours. (The data are plotted from Knoblauch, O. 1897, *Ueber die Geschwindigkeit der Esterbildung und Esterzersetzung*, Ztschr. f. physik. Chemie, 27, 268). The lower curve shows the approach to the fatigue level in a contracting muscle. This curve is an enlargement of one end of an ergograph record by Hough (See Fig. 3) *inverted* and smoothed out. In both the simple and complex reactions, the accumulation of acid is the limiting factor. As the curves become increasingly asymptotic, they approach a condition of dynamic equilibrium.

2. *Muscular Work and Fatigue*

This discussion of dynamic equilibrium has brought us to the very center of our problem of fatigue. Fatigue may normally (Note 4) be considered a condition of lowered capacity for work, resulting di-

rectly from the accumulation of the products of activity and varying with the duration, rate and intensity of the performance and the initial strength or capacity of the physical system involved (Note 5). We have purposely omitted here any reference to the supposed phenomenon of mental fatigue. The status of the problem involved in this conception will be discussed in a later section (p. 30). The existence of central or mental fatigue is inferred, but the experimental evidence is by no means satisfactory and cannot well be treated on the same basis as that for physical fatigue.

The experimental investigations of fatigue (we shall understand the term in this discussion to mean *normal* fatigue) are mainly of two sorts: one, experiments upon excised muscles or nerve-muscle preparations of frogs and small mammals; and two, experiments upon human subjects in which single muscles or a limited group of muscles are exercised until their working capacity is much reduced or has disappeared completely. In both types of experiments the muscle is required to raise a weight, and the electrically or voluntarily induced contractions are recorded by means of a lever upon a revolving smoked drum. In both excised and intact muscles fatigue has been estimated in three ways:

I. A muscle is forced, by natural or artificial stimulation, to work against a heavy and rapidly exhausting load, and either the time required for the complete loss of contractility or the time required for the *recovery* of the original irritability is taken as an index of fatigue.

II. A muscle is forced to work against a moderate load, and the time required either for exhaustion or for a return to normal contractility is taken as the fatigue index. This method differs from I only as regards the selection of the weight.

III. A muscle is forced to work against a load so chosen that the height of the individual contractions of the muscle is reduced but reaches a constant level beyond which further reduction does not occur. In this case either the height of the fatigue level or the time required to reach that level is chosen as the fatigue index.

A moment's consideration will make it clear that in a given muscle, *provided the rate of contraction remains constant* (Note 5), the only quantity that varies as we progress from I to III is the size of the weight. The interrelations of the three methods for estimating fatigue may best be shown by a simple diagram combined from a study of a great number of fatigue curves. The figure is particularly significant for the cases where the circulatory system is left intact. If we plot the time as abscissae and the height of the contractions as ordinates (Note 5) and keep the working rate constant, we find that with a *heavy* weight we get curves like 1 and 2 (I). (Mosso, 1890, I; Ioteyko, 1903, I).*

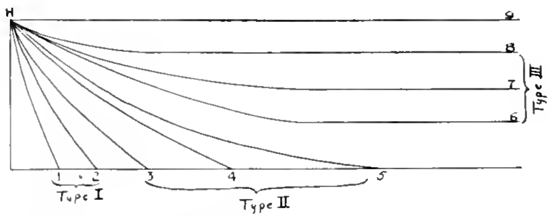

FIG 2.—A diagrammatic representation of the types of curves observed in various investigations of muscular fatigue. All fatigue investigations show curves belonging either to Type I, II or III. A detailed explanation of the practical and theoretical significance of curves of Type III is given in the text.

With a lighter weight, we get curves of the 3, 4 and 5 (II) type (Fletcher, 1902, 2, II; Lee, 1902-1907, 1906, I and Fig. 4), and with still lighter weights a fatigue level appears, like that shown in 6, 7 and 8 (III), (Hough, 1901, II and Fig 3 of this paper). As we pass through the series from 1 to 9 the fatigue curves gradually become more and more asymptotic. Finally, with extremely small weights, the height of the contractions remains constant. In this case there is no indication of fatigue (Note 6).

In our consideration of the various forms of fatigue curves we have assumed the working rate to be constant and the weight alone to vary. Experimentation has shown that a similar group of curves may be obtained by keeping the weight constant and changing the rate of work. In other words: "The height of the fatigue level varies inversely with the rapidity of the rhythm of contraction" (Hough, 1901,

*Text references indicate the author, the year of publication, and the number of the division in the bibliography in which the article is listed

H.). Fig. 3 illustrates precisely this point very strikingly. After the muscle had contracted for six minutes at a rate (Note 6) of $\frac{C}{R} = \frac{\frac{1}{2}\text{ sec.}}{\frac{3}{4}\text{ sec.}}$ the rhythm was changed to $\frac{C}{R} = \frac{\frac{1}{2}\text{ sec.}}{1\frac{1}{2}\text{ sec.}}$ The muscle promptly rose to its original level and remained there as long as the slower rhythm was maintained. This rise in the height of the contractions with a slowing down of the rhythm corresponds to a shift from curve 6 to curve 9 (Fig. 2), to the level of *no fatigue*. Here, then, is a case of continuous work without an accumulation of fatigue. Obviously, the working rate is very slow.

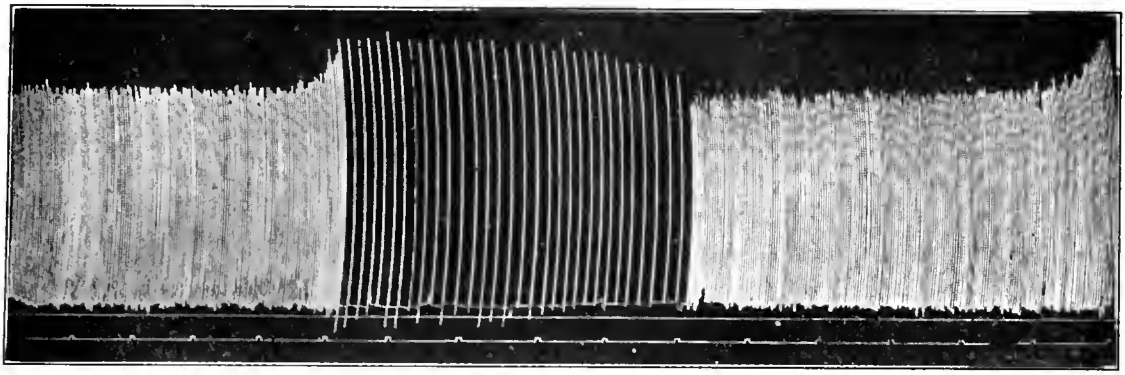

FIG. 3.—A fatigue curve of Type III (Fig. 7, Hough, 1901, II, p. 253) showing the importance of the rate of activity. The fatigue level is abolished after six minutes by changing the rate from $\frac{C}{R} = \frac{\frac{1}{2}\text{ sec.}}{\frac{3}{4}\text{ sec.}}$ to $\frac{C}{R}\ \frac{\frac{1}{2}\text{ sec.}}{1\frac{1}{2}\text{ sec.}}$. The fall in the height of the contractions during the first two minutes of the rapid rate indicates the accumulation of lactic acid and other metabolites. It is this fall (from Hough's Fig. 6, loc. cit.) that we have inverted and plotted in Fig. 1. At the fatigue level the muscle is in dynamic equilibrium.

If we turn now to a consideration of the practical question of muscular efficiency, we may say at once that fatigue curves of types I and II do not occur under normal human working conditions. In the course of our daily activities we never exhaust our energies to the point attained in the case of the ergographic records, where one more movement becomes literally impossible. This means that, so far as practical considerations go, we have to deal only with curves of type III. What we are really interested in, practically, is not how long a muscle will require for complete exhaustion or for recovery from complete exhaustion, but how it may operate so as to produce the greatest amount of work, in a given period of time with the least fatigue. And, strange as it may seem, this precise question has never, so far as we know, been experimentally answered by the physiologists (Note 7). Maggiora (1890, II) appears to have been the first investigator clearly to recognize the practical possibilities of intercalating sufficient rest periods between muscular contractions. Using a weight of 6 kg. on Mosso's finger dynamometer, he raised it at a rate of once every 1, 2, 4, and 10 seconds. The mechanical work accomplished by the finger muscles in the course of an hour was found to be thirty-two times as great at the ten second rate as when the contractions were made every four seconds. Maggiora makes the following interesting comment (p. 199): "On a ainsi, pour les muscles de la main, la repetition de ce qu'on observe pour le muscle cardiaque, avec cette difference que, pour le premier, le rhythme doit etre de 10″ pour qu'ils se reposent completement et qu'ils travaillent pendant un temps indefinis."

With an improved apparatus Hough (1901, II) obtained very constant results (Fig. 3) from the contractions of the mm. flexores digitorum of the second and third phalanges of the middle finger (See also Schenk, 1900, IV, 3). The striking uniformity of his curves suggests that his technique might throw much light upon the theoretical question of a muscle's maximum efficiency (Note 8). (Amar, 1915, IV, 3; Ausscheutz, 1914, IV, 3; Bergstroem, 1903, IV, 3; Broca et Richet, 1898, IV, 3; Camus, 1915, 1 & 2, IV, 3; Grandis, 1903, IV, 3; Hough, 1900, IV, 3; Ryan &

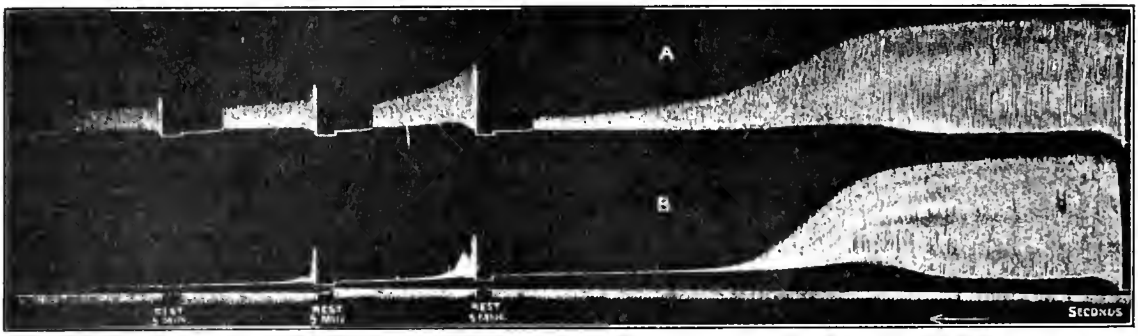

FIG. 4.—Fatigue curves of Type II (Fletcher, 1902, II, Fig. 7, p. 490). This figure shows that oxygen is essential for the recovery of a fatigued muscle, i. e., for the removal of lactic acid after exhaustion. In the upper curve the muscle was kept in an atmosphere of nitrogen and showed only the faintest trace of recovery. The tracings were made by a pair of excised frog's gastrocnemius muscles.

Agnew, 1917, IV, 3; Treves, 1905, I). It is, of course, commonplace knowledge that periods of rest will increase subsequent working capacity. But is it more efficient to slow down the working rate as a whole, i.e., to work for long periods at a slow $\frac{C}{R}$ rhythm, or to work in a series of spurts—a rapid $\frac{C}{R}$ rhythm with frequent periods of complete rest? The efficiency engineers (Taylor, 1911, VIII), claim to have answered this question for the human organism as a whole at least as regards one type of individual, but a definite physiological foundation through carefully controlled laboratory experiments remains to be established (Benedict & Cathcart, 1913, II).

3. *The Varying Energy Level*

In defining fatigue above as the diminished capacity for work we have attempted to draw attention to the fact that this definition is appropriate only for normal fatigue. Scrutinizing the definition further under conditions, which, if not strictly speaking *usual*, are still not uncommon and cannot therefore be called actually abnormal, we find that it is far from adequate. In the first place, it is evident that working capacity may be and frequently is lowered by conditions other than fatigue. And, in the second place, the presence of fatigue is not invariably indicated by a lowering of the capacity for work. This latter criticism brings to mind at once the familiar phenomenon of "second wind." We normally stop an occupation when we meet what William James (1907, 1, I), has vividly called "the first effective layer of fatigue," but if some unusual necessity forces us to continue our activity we find that our sensation of weariness gradually or suddenly passes away and we feel fresher than before. "We have evidently tapped a level of new energy, masked until then by the fatigue-obstacle usually obeyed." (James, loc. cit.). Now these sudden accessions of energy, of which our daily life shows so many examples, have "rendered well nigh futile all the many attempts hitherto made to obtain reliable objective measures of degrees of fatigue of the organism as a whole" (McDougall, 1908-1909, I). "It seems impossible," McDougall continues, "to get the physiologists of the laboratory, the physiologists who are chiefly concerned with the organs rather than the organism, to consider this conception seriously and on its merits. If they occasionally refer to it, it is only to put it aside contemptuously as a naïve survival from the dark ages. Yet those who are in the habit of dealing with the problems of the organism as a whole, the physician and the psychologists, constantly make use of this conception, for they find it impossible to make progress in the understanding of their problems without it. That fact gives the conception a claim to a more serious consideration than it has commonly received from the physiologists." It is not surprising that James's suggestion of "reservoirs of power" and "layer after layer" of potential energy should have been tendered a cold reception among the physiologists. Such purely figurative expressions without factual basis present no object for experimental attack—without which the physiologist is both skeptical and helpless. Since McDougall wrote the words quoted

above, however, Professor Cannon (Cannon, 1915, VI), and his students have thrown a flood of light upon the whole question of energizing influences.

Cannon (loc. cit., p. 217) states that so far as the physical exhibitions of power are concerned, certain highly serviceable bodily changes, some of which are associated with an astonishing increase in muscular efficiency, exemplify concretely and definitely these figurative expressions of the psychologists. The way in which this increase in muscular efficiency is brought about is as follows. Under the stress of emotional excitement and through the action of the sympathetic nervous system, there is poured into the blood from the adrenal glands a secretion of adrenin, a substance having a number of remarkable properties. For example, injected adrenin causes a liberation of sugar from the liver; and sugar, as we pointed out above, is probably the chief source of the high potential energy in muscular activity. Here then is one "energy reservoir," expressed in simple physiological terms. Another way in which adrenin serves to increase muscular efficiency is by increasing the rate and force of the heart beat and therefore the flow of blood through the working muscle. The fatigue products (lactic acid and other substances), are thus promptly swept away and prevented from impairing muscular efficiency. An even more remarkable action of adrenin is its power of restoring the irritability of muscle after the ability to respond to stimulation has been very much diminished by prolonged activity. Cannon (loc. cit., p. 133) says: "What rest will do only after an hour or more, adrenin will do in five minutes or less." (Gruber, 1914, II; Cannon & Nice, 1913, IV, 6; Lagrange, 1912, I). In this case the adrenin seems to act both on the motor nerve plate and on the muscle substance itself.

"It would doubtless be incorrect to attempt to account for all the increased strength and tireless endurance, which may be experienced in periods of great excitement, on the basis of abundant supplies provided then for muscular contraction, and a special secretion for avoiding or abolishing the depressive influences of fatigue" (Cannon, loc. cit., 217). There occurs simultaneously an immensely augmented activity of the nervous system which is of great significance. Anyone who has ever had occasion to work at high tension under great emotional stress for a considerable period knows that the increased efficiency is a temporary matter. Adrenin production cannot be substituted for sleep and normal rest indefinitely. If we draw too deeply and continuously upon our reservoirs of energy we may develop a condition of hyperaesthesia and ultimately suffer a complete nervous breakdown. Thus the same physiological mechanism which will carry the human organism through critical situations by releasing normally inaccessible sources of energy, may ultimately cause practically a complete loss of working capacity. And, as everyone knows, the recovery from a nervous breakdown is a long and tedious process. A reason that is frequently advanced to account for the slow recovery from a condition of hyperaesthesia is based in part upon the experimentally established fact that after extreme muscular activity certain histological changes may be observed in the brain cells (Purkinje cells), and the recovery of these cells is believed (for no very clear reason) to be an exceedingly slow process (Hodge, 1889, III; Vas, 1892, IV, 6; Mann, 1894, IV, 6; Eve, 1896, IV, 6; Pugnat, 1901, III: Dolley, 1916-1917, 1917, IV, 6, and others). The experiments of Cannon and his students suggests a different explanation. In the condition of nervous breakdown one outstanding symptom is an abnormal facilitation of conduction in the nervous system. Cannon's work suggests to us that this condition may be due to some chemical change brought about by the action of adrenin either centrally or at the synopses. Such a change would constantly tend to be maintained by the addition of further adrenin to the circulating blood. Recovery would consequently be a long and slow process. From this point of view, nervous breakdown would really be a condition of adrenin poisoning. This conception is probably open to experimental verification (Note 9).

The psycho-physiological effect of certain dynamogenic words such as *Truth*, *Science*, *Liberty*, *the Flag*, etc., are familiar enough. Nearly everyone has experienced an accelerated heart beat and often a feeling of suddenly increased power

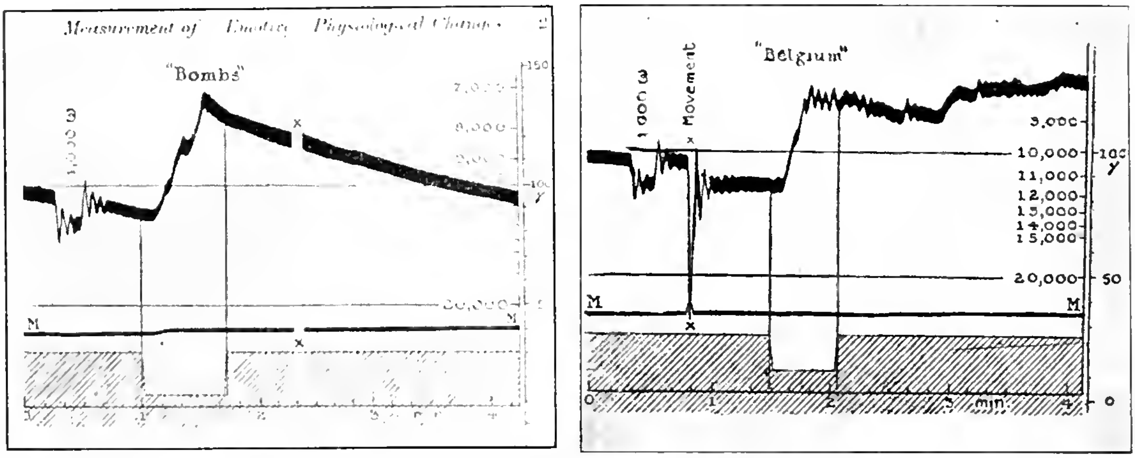

FIG. 5.—Galvanometric measurements made by Professor Waller (1918, VI), showing the psycho-galvanic effect of the energizing words, *Belgium* and *Bombs* upon two individuals who had experienced the Belgian invasion and air raids on Paris respectively. The phenomenon is clearly shown by the rise in the shadow tracing of the galvanometer string. In both cases new levels of energy have been tapped.

at the sound of some suggestive word. Our Figure 5 shows the effect of two energizing words upon the psycho-galvanic reflex of individuals who had had harrowing experiences in the war. In these cases of psycho-galvanic changes the effects of the words *Bombs* and *Belgium* could be directly recorded by Professor Waller with the string galvanometer (Waller, 1918, VI). Such examples are additional objective verifications of the fact of sudden accessions of energy. Combined with our recently acquired knowledge of the physiology of the sympathetic nervous system they constitute an objective basis for further experimental study.

If, then, we are actually in a position to release layer after layer of energy under emotional stress, our problem of fatigue becomes tremendously more complex. Indeed, to say that fatigue is a diminution of working capacity (Florence, 1918, VIII), a definition that constantly appears in the literature, may cover all those cases, such as many of the laboratory experiments, in which no emotion factor complicates the result. But, with the wide range of emotions that occur in different individuals under varying conditions of daily life, especially under the conditions of industrial life, fatigue comes to mean something quite different from a simple diminution of working capacity. We may qualify our original definition, then, by saying that under normal conditions, in the absence of emotive stimuli, fatigue is expressed by a lowering in the capacity for work of the normal individual. On the other hand, in the emotional individual or, under the stress of emotive stimuli, in the normal individual, the presence of fatigue is frequently obscured or masked by a quality and quantity of work that would ordinarily indicate the opposite of fatigue. We recognize fully that in speaking thus we are using the word normal in a loose fashion. As a matter of fact, it is impossible to state at present whether the absence or the presence of emotive stimuli or the unemotional or the emotional individual represents the normal situation. But we feel assured that in the search for a definition of and a touchstone for the condition of fatigue, the emotive situation is too common and too significant to be left out of account.

4. *Central Fatigue*

In our discussion of the nature of muscular fatigue we stated that in muscular activity we have a condition of dynamic equilibrium; when the muscle ceases to respond to a stimulus it is because of the accumulation of the products of metabolism, chiefly lactic acid. Now the work of Abelous (1893, I), Santesson (1895, II), Ioteyko (1903, I), Waller (1885, I), and others has shown that when a muscle will no longer respond to a stimulus through its nerve fibre, it may readily be contracted by stimulating the muscle directly. There appears, therefore, to be

little doubt that the conduction over the motor end-plate within the muscle substance may in some way be blocked by the metabolites. According to these authors, fatigue first interferes with function at some peripheral point. Mosso (1900, I), however, contended that natural fatigue, that is, fatigue brought about by voluntary effort and not by artificial stimulation, is a distinctly central phenomenon. He and Lombard (1890, IV, 3) and Waller (loc. cit.) all claimed that intact human muscles which were completely fatigued for voluntary stimuli could still be contracted by electrical stimulation. Whereas this fact alone does not dispense with the possibility of motor end-plate fatigue, Mosso held (for no very clear reason) that the cause of the loss of voluntary nerve stimulation lay in a depletion of the vital or nervous energy of the entire organism. Subsequent work by Kraepelin (1892, VII), Hough (1901, II), Woodworth (1901, III), Mueller, R. (1901, IV, 3), Storey (1903, 3, IV, 3), and Ioteyko (1903, I), showed that the muscles that had been voluntarily contracted and those that were artificially stimulated were not the same muscles. These experiments serve to invalidate entirely the conclusions as to the fatigue of the central nervous system postulated by Mosso, Lombard and Waller.

The most convincing evidence regarding the locus of fatigue is furnished by the brilliant experimental work of Professor Sherrington (1906, II). A lucid account of this work has recently been given by Ash (1914, VI) as follows:

"Professor Sherrington of the University of Liverpool whose researches into the action of the nervous system have extended the knowledge of that branch of physiology farther perhaps than those of any other investigator, does not believe that central fatigue is due to conditions or changes within the bodies of the neurons. His theory is that the connection between the different neurons is not one of continuity but of contact. This point of contact he terms the synapse, and ascribes to it the first incidence of fatigue. One of his experiments by which he demonstrates this is as follows: A certain nerve center within the spinal cord is selected which forms a union between a number of afferent nerve tracts and a single efferent tract to a given muscle. One of these afferent tracts is stimulated and the stimulus passes through the common nerve center and over the common efferent tract and is thus neutralized in the contraction of the muscle. After a short time this muscular contraction weakens and finally ceases altogether. The stimulus is then applied to another of the afferent tracts and the motor response of the muscle is as strong as at first. Now since nerve fiber is known to be practically unfatigueable, and since the same nerve center, motor end-plate and muscle are involved in both series of stimulations, it is evident that the fatigue resulting from stimulating the first afferent nerve cannot be ascribed to any of these; hence Sherrington concludes that it must be ascribed to the synapse where the afferent nerve tract comes into contact with the nerve center. Professor Sherrington has also shown that if a particular spot on the skin of a 'spinal animal' be stimulated either mechanically (i. e., by pricking or scratching), or electrically, it will elicit certain reflex movements, notably the 'scratch reflex'; but just as in the former experiment, in which the afferent nerve tract was stimulated directly, this reflex movement will presently cease. But if a second point of stimulation be selected a short distance removed from the first, the movement will be immediately resumed. The fatigue from the first stimulations might in this case be ascribed to the sensory nerve endings within the skin. Sherrington, however, does not accept this view, but, on the basis of his results in the previously cited experiment and of others which need not be detailed here, he concludes that it is to the synapse, where the sensory neuron comes into functional contact with the motor neuron, that this initial fatigue must be ascribed."

The working and resting conditions of nerves and nerve cells are quite different from the corresponding conditions in muscle. We know that in the process of nervous conduction no measurable heat is evolved, which suggests that there is practically no energy exchange; nervous conduction can also continue indefinitely without apparent fatigue. Tashiro (1913, 1 & 2, II) detected a production of carbon dioxide during the conduction of the nervous impulse, which he attributed to a metabolic change in the nerve fiber resulting from conduction, but his results have not

been generally accepted. The criticism brought is that the carbon dioxide produced may either have been dissolved in the tissue or have been produced by the connective tissue cells which are always associated with nerve fibers in a nerve. (Bayliss, 1915, I, p. 379.) The metabolism of nerve cells, then, stands in sharp contrast to the chemical changes and heat production exhibited by working muscle. Nervous activity appears to proceed in an astonishingly economical fashion. The most painstaking attempts to demonstrate an energy exchange comparable to the quantity of mental work accomplished have failed. (Benedict & Carpenter, 1909, VI).*

The extremely difficult and intangible problem of mental work lies beyond the scope of this paper. We are quite content to agree with those psychologists who define mental work as "that part of the animal's work which physiology does not account for." (Thorndike, 1914, III, p. 4.) In the present state of our knowledge, central fatigue may be experimentally demonstrated at the synapses of the afferent or intermediate neurones, but the part, if any, that the neurone bodies play in central fatigue is not known. Such expressions as "brain fag" or "mentally tired" which we apply to the sensations of fatigue are popularly associated with the conception of wear and tear of the brain tissue. As a matter of fact, all attempts on the part of psycho-physiologists to demonstrate mental fatigue or obtain a quantitative measure of central fatigue are open to suspicion.

PART II: PRACTICAL

1. *The Tests for Fatigue.*

Ever since the significance of fatigue in connection with school work and industrial processes first began to be recognized, repeated attempts have been made to discover some method for detecting the signs of impending fatigue or of its actual presence. In spite of the conviction that in fatigue we are not pursuing a will-o'-the-wisp but an actual and presumably measurable physical or physiological condition, we must admit that a clean-cut test for general fatigue in man has not yet been discovered. The sensations of fatigue are so universal and easily recognized that the earlier workers were apparently misled into believing that a universal touchstone for fatigue could easily be discovered. In this they were mistaken. The work of the past forty years has gradually convinced physiologists and psychologists of the baffling complexity of the problem; and today we are inclined to be skeptical as to the possibility of finding an unequivocal solution. Are not the variables so numerous that we can never hope for more than some general indications of fatigue, an *effort syndrome*, or combination of symptoms that will point to a vague and general lowering of physiological potential? When we consider that working capacity varies from one individual to the next not only with actual physical or mental equipment, but with such fluctuating factors as general health and habits, interest, training and temperament; and when we recall that the continued exercise of simple functions diminishes the efficiency in other functions in varying degrees, we have mentioned but a few of the complicating factors. Into this mass of complexly interrelated and immeasurable variables the statisticians and psycho-physiologists have plunged, hoping to emerge with a universally valid test for general fatigue. While their efforts have, not surprisingly, been only partially successful they have nevertheless achieved a significant pointing out of the various complicating factors involved in situations in which fatigue presumably plays a part and they have indicated methods by which the problem may be further attacked.

I. Statistical Methods

The practical statistical treatment of the fatigue problem in pedagogy and industry has dealt primarily with output per unit of time. Industrial accidents have also attracted much attention, being suspected of an intimate relation with industrial fatigue. Also general health, consumption of power and proportion of spoiled work have all been suggested as possible measures of industrial fatigue. The most recent analysis of factory statistics in rela-

*Professor Ralph Lillie has recently offered an explanation of nerve conduction based on an analogy with the passage of a wave of electro-chemical activity over the surface of "passive" iron wire. A discussion of this analogy, which seems to us the most significant and helpful in understanding the phenomena of nerve conduction that has so far been suggested, will be found in Science, N. S., 1918, 48, 51.

tion to industrial fatigue is that of Florence (1918, 1, VIII). This author reviews and expands much of his previous work carried on as a member of the British Health of Munition Workers' Committee. Florence is well aware of the multiplicity of variable factors involved in his study and he strikes a warning note at the outset (loc. cit., p. 25) : "It is imperative. . . . for the investigator to set clearly before himself all the factors in industry that may predispose the human organism to fatigue . . . (so) that he may secure evidence as to the comparative importance in fatigue-production of all these different industrial conditions." He then gives a a schedule of these conditions, partly the result of his own practical experience and partly a re-combination of individual and departmental schedules (Weber, 1908, VIII; Roth, 1907, VIII; and Florence, 1917. Interim Report of British Health of Munitions Workers' Committee) previously published. Since "this table has been found of great practical use in the field . . (and) . . may serve as a questionnaire or blank form to be filled in by social investigators," we reprint it in full.

SCHEDULE OF INDUSTRIAL CONDITIONS

I. Length and Intensity of Activity.
II. Factory Conditions: Hygiene and Employment Management.
   A. *Physical: Time and Place of Work.*
      1. Air: Temperature and Humidity; Ventilation and Roomspace; Dust and Fumes, Exhaust Systems; Smell.
      2. Light: Volume, Concentration, Glare.
      3. Noise: Volume, Irregularity, Vibration.
      4. Accident Hazards: Safety Devices; First Aid.
      5. Feeding: Sale of Food; Equipment; Service.
      6. Sanitation: Drinking Water; Rest Rooms; Baths.
   B. *Social and Economic.*
      1. Flow of Work. Depressions and Rush Orders. Routing.
      2. Creation of Staff. Appointment and Dismissal. Permanency of Tenure. Unemployment. Instruction and Supervision.
      3. Maintenance of Production. Incentives: Natural interest in work. Scale, method and assurance of wage payment. Discipline.
III. Nature of the Work.
IV. Type of Workers.
   A. *Sex. Age. Race.*
   B. *Experience.* Date of Entering Industry and Factory. Former Occupations.
   C. *Habits and Home Conditions.*
      1. The Amount and Use of Earnings. Thrift.
         Food: Diet and Time of Meals.
         Stimulants: Alcohol and Tobacco.
         Sleep and Recreation: House Accommodation and Hygiene.
         Support of Dependents.
      2. Method and Length of Transit from Home to Work.
      3. Duties outside Factory (Housework of Women, etc.).
      4. Sexual and Family Relations.
   D. *Point of View* ("Animus"). Trade-Unionism, Patriotism, Economic Self-interest, Herd-Instinct, etc., General Intelligence.

A. *The Output Rate.* Output rate has frequently been selected as a measure of working capacity either of individuals or groups. It is often difficult, however, under factory conditions to obtain exactly comparable units in which output may be measured, and in the case of self-feeding, automatic lathes or looms, where the worker only watches or attends the machine, output measures only the mechanical efficiency of the machine, irrespective of the working capacity of its attendant. Accordingly, in the collection of data the investigator must guard against variations of this sort. The usual method of representing output data is to plot the time against units of output. Curves of this sort (Lee, 1918, 2, VIII, p. 12 & 17; Kent, 1916, 2, VIII), where individual output is considered, vary remarkably, but by averaging a large number of curves it has been estimated that the average output of workers generally reaches a maximum some time between 10 A.M. and noon, and drops off to a minimum toward the closing hour. It is significant to observe that when the output is being deliberately controlled, that is, when operators are "soldiering" or obeying some previously ar-

ranged agreement, the output curve shows no such regular afternoon drop.

Presuming all the data to be valid, the question now arises as to what light the output curve throws on the occurrence of fatigue. We may say at once that if by fatigue we mean a lowered capacity for work, and the drop in output indicates a lowered capacity for work, it must simultaneously indicate, by definition, the presence of fatigue. How much of this fatigue is due to the work and how much to other conditions, output curves do not tell. Several neglected variables have occurred to us in studying the output curves in the fatigue literature. In the first place, *working capacity* is not a constant factor even when little or no fatiguing work has been done. Experiments of Lombard (1892, IV, 3), Storey (1902, V), and others indicate that there probably is a diurnal fluctuation of individual capacity, just as there is of temperature, due to some sort of little-understood central drift. At present our knowledge of this condition is most fragmentary. The morning rise in efficiency is common to both the experimental and the factory output curves. A similar morning rise was found by Martin, Withington & Putnam (1914, IV, 4) in studying the threshold sensitivity of medical students engaged in a regular and strenuous routine. The afternoon drop was observed by Lombard (loc. cit.), but Storey (loc. cit.) records a *rise* in efficiency about 4 P.M. An ergographic study of the normal variations in working capacity under resting conditions, for example among accident or surgical cases in a hospital ward, where approximately normal metabolism may be expected, might throw valuable light on this phase of the output problem. Is the diurnal variation similar for all individuals, and does the curve parallel the factory output curves?

A second variable affecting the output curve involves the question (see p. 26) of the *energy level* at which the individual works. Whereas normally the onset of fatigue lowers an individual's output, under the stress of an emotive stimulus, both working capacity and output may be increased. If the emotive stimulus is sufficiently prolonged (as, for example, in certain domestic situations involving a sick child, an intemperate or lazy wife or husband) it may gradually bring about a serious pathological condition, ultimately a complete breakdown. In cases of this sort, called *abnormal,* but common enough under the nervous and economic strain of modern industrial routine (Goldmark, 1912, VIII), the detection of the gradually accumulating fatigue by a study of output is out of the question. The extent to which this variation of the capacity base line may influence mass output statistics has never been determined. Indeed, the systematic investigation of the entire question of varying energy levels has scarcely begun.

In the study of working capacity, Florence states that "two methods of procedure are possible. Particular cases must either be carefully selected where all factors are known and measurable and no ambiguity exists or need exist, i.e. where data are naturally unambiguous or else subject to control; or, on the other hand, extensive 'mass' statistics must be collected, yielding a sufficient number of cases to eliminate *in the average* all chance ambiguities that do exist." Just what the averages of such mass statistics are intended to reveal Florence does not say, though he states that they "will point the way where detailed causal analysis is most necessary." There seems to us to be one outstanding difficulty in any attempt to detect fatigue by average values of mass statistics. Fatigue is clearly a condition which does not affect all the individuals working at a given task to the same degree; by averaging results of output we obtain a value which obscures both the poorest records and the best records and since normal fatigue is found to a greater degree among the less efficient workers, we thus get a false impression of the working capacity of precisely the individuals we are most anxious to reach. Florence's suggestion that intensive studies of the capacity of individual workers should be made would probably remedy the situation and might, as he hopes, supply a "composite figure that is representative of the results of normal conditions of bodily and mental health and of normal factory management." (Florence loc. cit., p. 37). We believe with Florence that too much emphasis cannot be laid upon the importance of an intensive study of individuals.

B. *Industrial Accidents.* Turning now to a brief consideration of accident distribution as a measure of fatigue, we may say

at once that because of numerous peculiarities in the accident variations actually observed there has been little unanimity of opinion among the investigators as to whether the accident rate expresses human working capacity at all. Detailed studies of the causes of accidents (Bogardus, 1911, VIII) have shown that a large percentage of accidents are avoidable by the injured. Lee (1918, loc. cit., p. 73) states that: "Most accidents have, in part, a physiological origin. Of the various conceivable physiological causes two, inexperience and fatigue, are especially potent." He illustrates the correlation between inexperience and the number of accidents in the case of a large munition factory during a period of seven months (p. 75) by a most convincing graph. The second correlation, between fatigue (as indicated by diminished output) and accident distribution in the course of a day is far less warranted by the evidence. Lee states (p. 14) that: "Most of the tabulations that have been made agree in showing that as output diminishes in each spell, coincident with the progress of fatigue, accidents increase in number—the curve gradually rises through the spell." Our own study of output curves has led us to quite a different conclusion. The outstanding feature of a large number of investigations is the contradictory nature of the relations that appear to exist, in the morning and afternoon spells, between output and number of accidents. Except in the case of heavy muscular work (Lee, loc. cit., p. 17), Lee's own figure as well as those of Florence (see particularly the instructive series of Accident Distribution curves on pp. 45, 47, 49, 55, 59 and 61 of Florence's *First Report*) show that output does not decrease progressively during the morning spell. There is an initial rise and in many cases output is at a maximum between 10 A.M. and noon (Fig. 6). During this same period accident frequency also rises and also often reaches its maximum. (Kent, 1916, 2, VIII). In the afternoon spell, on the other hand, when output decreases almost steadily, accidents again rise to a maximum, usually between 3 and 4 P.M. Thus output and accidents both *increase* throughout the morning, whereas in the afternoon output decreases while accidents attain a second maximum. In other words, when efficiency is measured in terms of output, accident distribution seems to be correlated in one case (A.M.) with an *increase*, and in the other (P.M.), with a *decrease* in efficiency. Clearly the relation between output and accidents is not so simple as Lee and others have supposed. Variations in shop lighting and in the constancy of the danger of operation are at least two factors which further complicate the situation. In order to place this question upon a firm scientific basis, we must have figures showing the output and accident distributions in the same group of workers during the same interval of time. The only available figures, so far as our experience goes, which approach these conditions, we have plotted from a table given by Florence (1918, 1, VIII, p. 66). In our figure the total output, as measured by power consumption, of a highly organized munition factory supplied the data. Of the figures Florence says (p. 65): "For each hour of work for six months the number of accidents is recorded." Until such data have been most critically collected and plotted, it is impossible to advance an opinion in the matter that shall have scientific validity.

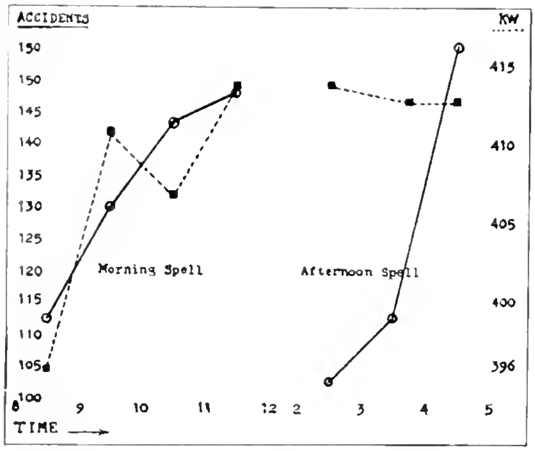

Fig. 6.—The distribution of accidents (solid line) and output as measured by power consumption (dotted line), plotted from data gathered by Dr. Florence. The number of accidents per hour for a period of six months supplied the figures in the left hand ordinate (*Accidents*). The kilowatt consumption per hour for the same period is given in the right hand ordinate. The absence of a consistent correlation between accidents and output is obvious.

C. *Lost Time and Sickness.* A recent study of sickness among industrial workers by Loveday is included in the Interim Report of the British Health of Munitions

Workers Committee (1917, 1, VIII). We agree with Florence when he says (p. 76) that: "Sickness records probably indicate an extreme stage of fatigue among a few and a diminished working capacity among many." The former case would include incipient or advanced psycho-neuroses, the latter what we have termed *normal* fatigue. The sickness records are particularly valuable and significant when a plant is experimenting with a change of hours; an increase in sickness rate whether hours are increased or diminished would be a valid cause for suspecting an increase of fatigue among the workers. It must be kept in mind that the output figures attained under either a reduction or increase in working hours will say nothing of the presence of fatigue unless careful sickness and lost-time records are kept. An increased output with shortened hours, for example, may be the result of anxiety on the part of the workers lest their wages should be reduced, not necessarily a sign of reduced fatigue and increased efficiency. We shall discuss this question somewhat further in connection with our consideration of industrial efficiency.

II. Psycho-Physiological Methods

An excellent critical résumé of the various psycho-physiological tests that have been proposed for diminishing functional capacity, both mental and physical, will be found in Whipple's *Manual of Mental and Physical Tests* (1914, VIII, Vol. 1). Whereas many of these tests have an important theoretical bearing upon the problem of normal fatigue, their practical application in the case of industrial fatigue has been disappointing. In its second report (1916, VIII, p. 17), the Committee on Fatigue of the British Association for the Advancement of Science states that: "On the whole, in spite of their experiments in school and laboratory, the work of the psychologists is still for the most part the reverse of illuminating for the problems of industry." There appear to be two chief reasons for the small success attained in applying psycho-physiological laboratory methods in the factory. 1. It is obviously impossible to reproduce factory processes and conditions in the laboratory or laboratory conditions in the factory; and 2. Psycho-physiological tests have frequently been introduced prematurely under factory conditions without adequate laboratory verification. (*Vide infra*, p. 34.)

In our discussion of neuro-muscular fatigue we have pointed out that the establishment of the existence of a fatigue level—a rate and amount of contraction which a muscle may attain and keep to almost indefinitely—is the most important practical contribution that ergographic studies of muscular activity have made. (Hough, 1901, loc. cit. and Schenk, 1901, loc. cit.) Quite apart from the fact that the raising of a weight by the repeated contractions of a single finger or finger joint does not in all cases adequately isolate a single muscle, ergographic work is very much more localized than any industrial process. Studies of the rate of recovery of completely and rapidly exhausted muscles have but little bearing on the rate of recovery of partially fatigued muscle groups resulting from a day of industrial activity.

The tapping tests in their various forms, the aesthesiometric tests and the computation and cancellation tests and many others of this type (Whipple, 1914, VIII, Vol. 1; Thorndike, 1914, III; Kraepelin, 1898, III; Binet, 1901, IV, 4; and others, see Bib. IV), are even further removed from the operations of industry than are the ergographic tests. As Muensterberg (1913, VIII) has repeatedly emphasized, unless the concrete situations are reproduced *in toto* in the tests, some essential and determining factor may have been overlooked. The various tests which we have just listed obviously represent highly artificial conditions and, as a rule, succeed in measuring only the degree of attention which the subject happens to give to the work in hand; they clearly lack objective validity.

In his two interim reports of *An Investigation of Industrial Fatigue by Physiological Methods*, Professor Kent (1916, 1 & 2, VIII) has experimented with no less than eight tests for fatigue, ranging from Kraepelin's modification of Mosso's ergograph to what Kent calls "a complex dilemma test." The latter consists in measuring the time that elapses between the disclosure of a colored card by a dropping shutter and the striking of a correspondingly colored key. In attempting to determine fatigue with this color test, the

reaction times in the morning and in the evening were measured in hundredths of a second. The reaction time is said to have been longer in the evening than in the morning, but a careful study of the tables (pp. 13, 14, 1st Report, 1916, 1, VIII) and the charts (No. 8, p. 19 and No. 9, p. 21, 2d. Report, 1916, 2, VIII), shows that in some cases the reaction time was longer and in other cases shorter after a day's work. Indeed tests made on the same individual on the same day showed in one case a rise and in another a fall in reaction time—variations which are after all not surprising when we consider that Kent's test requires the complete coöperation of his subjects. It is again mainly the attention factor that is actually in process of measurement, while the amount of variation obtained would alone be enough to make the test extremely doubtful.

In order to reproduce more nearly the working conditions of industry and especially the mental attitude of the worker, McDougall (1908, I, p. 487) has suggested a method for estimating fatigue which "seeks to keep interest at a maximum throughout, the task set being of the nature of a sprint." McDougall's test consists essentially in successfully jabbing with a pen at a series of irregularly distributed spots on a moving cylinder. The rate of the rotating drum is increased or decreased and the subject is given some other task to be carried on concurrently. This method claims, somewhat obscurely, to measure after a half hour's interval "the degree of fatigue produced by an effort sustained for only about three minutes." When we consider that by this test we are measuring loss of coördination capacity, it is evident that, under ideal conditions, the theoretical soundness of McDougall's method admits of no doubt. Inadequate coördination must be recognized as an outstanding cause of many industrial accidents, but coördination power is an exceedingly difficult factor to measure. The attention factor enters all purely subjective tests and an apparent loss of coördinating ability may in reality be a lack of interest or attention on the part of the subject. This complication might be partially met by the introduction of some simple incentive, an interesting monetary reward, for example, for the attainment of a certain score. The development of simple methods for measuring coördination power presents a most promising direction for further work.

The attention factor and other subjective complications have led numerous investigators to the study of more objective methods of fatigue measurement. Attempts have been made to correlate fatigue with a variety of simple and coördinated reflexes such as the knee-kick (Lombard, 1887, IV, 5; Dodge, 1910, IV, 5), the eyewink (Dodge, 1913, IV, 5), the pulse-rate (Binet & Henri, 1898, III), the blood pressure (Weber, 1914, IV, 3), and a modified vascular skin reaction of Maret (Ryan, 1918, IV, 5). In all these reactions the outstanding difficulty has been to correlate the magnitude of the changes in the reflexes with the degree of fatigue. In the case of the blood pressure Weber (1914, 2, VI, p. 290) has reported an increase with moderate muscular work but a distinct decrease when the working muscles become fatigued. If this reaction should prove to be uniform, it might serve as a useful index of fatigue but Weber's method has the practical difficulty of requiring complicated physiological apparatus. Furthermore, the method has thus far been applied, so far as we know, to trained laboratory subjects only.

Ryan's (1918, loc. cit.) test for fatigue consists in making, by means of an ingeniously devised blunt instrument, a stroke on the palmar surface of the forearm. After a brief interval a white streak appears and the duration of this streak, which is shorter in the fatigued individual, is a measure of the fatigued condition. According to Lee (1918, VIII, p. 15), "The curve of duration of the streak falls during the forenoon, indicating fatigue, rises somewhat during the luncheon hour indicating restoration, and falls again to a minimum during the afternoon. If the subject spends the half-day resting instead of working, the fatigue fall of the curve does not occur and a rise may result." An extensive experimental study of the practical applicability of Ryan's test to industrial conditions is being carried out under the Public Health Service. Our own limited experience with the skin reaction test has demonstrated: first, a wide variation of intensity in different individuals; and second, a lack of sharpness in the end point of the reaction, i.e. the beginning of the

fading of the white streak. The latter difficulty may be a question of experience and we must therefore reserve judgment until the report of the industrial tests appears.

A final group of fatigue tests are those involving the production of chemical changes in the body as a result of activity and the quantitative measurement of the chemical reaction products. Exact studies of lactic acid production in muscle working under laboratory conditions have shown very definite and constant relations to exist between the quantity of acid produced and the amount of work accomplished (Fletcher & Hopkins, 1917, II).

These results are of great theoretical significance but, obviously, do not constitute a practical method of attacking the question of industrial fatigue. More recently, however, Ryffel (1909, II) has shown that lactic acid may appear in the urine after extreme muscular exercise; and Hastings under the direction of Professor Lee has found (Lee, 1918, loc. cit.) that the urine of day-workers in munition factories has a higher order of acidity (hydrogen ion concentration) in the evening than in the morning. Resting subjects used as controls showed just the opposite condition—a slightly greater alkalinity in the evening than in the morning. The nature of the diet must of course be taken into consideration in all measurements of urine acidity. It is well known that a high percentage of meat will increase the urine acidity, while a vegetable diet causes the urine to show a lower order of hydrogen ion concentration. These variables must be carefully controlled before we can hope to obtain quantitative estimates of fatigue by urine acidity measurements, an experimental necessity that Hastings clearly appreciates, for the diet factor in general, and the complications brought about by varying diets, are now being investigated under carefully controlled experimental conditions.

III. Conclusions Regarding Tests for Fatigue

Our study of the various methods that have been suggested as tests for fatigue has brought up a number of questions and led us to the following conclusions:

1. Statistical studies of output, which show production falling off toward closing time give no accurate picture of the degree to which the lowered working capacity, i.e. fatigue, is due to the work that has been done. Diurnal fluctuations in working capacity and long continued emotive stimuli may affect individual output curves so as to render the commonly accepted inverse correlation between output and fatigue invalid. To say that such individual fluctuations will disappear when mass output curves are plotted is true, but serves only to obscure the answer to the question of fatigue in the cases of the fluctuating individuals. Since normal fatigue is associated more with the less efficient workers, and accumulative fatigue is often associated with a high output, *intensive studies of individual outputs and general health are urgently needed.*

2. What is the relation between the distribution of accidents and fatigue? Why do accidents and output both increase in the morning spell and accidents reach a second high point in the afternoon when output is falling off? An extended study of accidents and output in the same group of individuals is suggested as a means of furnishing a statistical background from which valid deductions may be made.

3. Psycho-physiological tests for fatigue which presuppose the sincere coöperation of the test subjects are impracticable under industrial conditions.

4. Coördination tests that are in the nature of a "spurt" (McDougall, 1908, loc. cit.; Miles, unpublished experiments), and present a chance to make a definite "score," reproduce more nearly the psychological conditions of industry. This type of test offers a hopeful field for further work.

5. Of the various reflexes that have been suggested as correlates of fatigue, nearly all show such wide variations that no unanimity of opinion exists as to the quantitative significance of these variations. Weber's test showing a rise of blood pressure with moderate work and a distinct fall after extensive work and the onset of fatigue (as shown by an ergographic record) may prove to be of value in detecting normal fatigue. Exact quantitative relations between rise and fall and the degree of fatigue have not yet been established.

6. Objective tests for fatigue such as Ryan's vascular skin reaction and Hasting's test of urine acidity may, upon further critical development, and control,

prove to be of practical aid in detecting "normal" industrial fatigue. Complete reports of these two tests have not yet appeared.

2. *Industrial Fatigue and Efficiency*

In examining the condition and possible prevention and cure of industrial fatigue, we are primarily interested in the lowering of working capacity, either immediately or ultimately. The angle from which the problem is most usefully attacked is that of efficiency—what we are concerned with is the human working machine—how best to steady, increase and conserve its efficiency. Fatigue in this connection comes to mean really a cumulative effect, a more or less permanent lowering of working capacity due to a condition of overwork or overstrain resulting typically from a too rapid consumption of the industrial worker's available energy. The available working energy has been consumed at a rate exceeding the rate of restoration of energy during the worker's rest hours. The fatigued industrial worker is not, then, simply the individual who is weary at the close of a day's work but one who, having rested insufficiently, comes to his job, day after day, with a diminished working capacity. Workers suffering from "industrial fatigue" are spending their physiological capital; and may ultimately come to bankruptcy in the form of a complete breakdown. The problem of industrial fatigue boils down, then, to the practical question of detecting the signs of incipient psycho-neuroses and guarding against the onset of these conditions.

It is of the utmost importance to bear in mind the fact that the familiar bodily sensations of weariness are in no sense a reliable index of the true state of diminished working capacity. We have seen in our consideration of the theoretical aspects of muscular fatigue that a diminished capacity for work advances progressively and may be well developed before the individual becomes conscious of any sensation of weariness. This is particularly apt to be the case under the pressure of an emotive stimulus, which, if protracted, may lead to a mild or ultimately to an extreme form of nervous breakdown. The past four years have provided abundant examples of long drawn-out intensive activity. Every conscientious person has been working at something with an unusual drive, and throughout the country the industries have been urging increased output by every sort of emotional as well as financial appeal (Note 10). In passing through the factories one saw the national emblem almost invariably in evidence together with signs bearing the familiar "Do your bit", etc., or, specifically, "The Germans are making more propellers than we are! Are *YOU* responsible?" etc. These tactics on the part of the industries have probably resulted in a depletion of the general health of industrial workers—to what extent we cannot gauge at present. Moreover, any attempt to estimate the causes of the present widespread industrial unrest must not fail to take into consideration the inevitable reaction from the prolonged state of high nervous tension since 1914. Actual war conditions obtained in the United States, relatively for so short a period, that the relation between output and increased hours has been less extensively investigated than in Great Britain, where the need for increased and speeded output was more drastic and lasted over a longer time. In Great Britain, also, industrial managers very naturally attempted to increase output by emergency tactics.

In the munitions factories hours were frantically increased, resulting, to the astonishment of the employers, in an alarming decrease in output. The situation was so serious that a committee was appointed by the British Minister of Munitions with the concurrence of the Home Secretary "to consider and advise on questions of industrial fatigue, hours of labor and other matters affecting the personal health and physical efficiency of workers in munition factories and workshops" (Florence, 1918, 1, VIII). Under the chairmanship of Sir George Newman, M.D., and with the coöperation of numerous other medical authorities and government factory inspectors, the committee published twenty memoranda and one Interim Report. (U.S. Bureau of Labor Statistics, Bulletins Nos. 221, 222, 223, 230, VIII.) Before considering in detail the important results and conclusions of the British Munition Workers Committee, we may briefly discuss three classical industrial experiments dealing with the relation of output and efficiency to the length of the working day.

I. The Length of the Working Day

One of the earliest industrial experiments in shortening the day's work was carried on during 1893 at the Salford Iron Works at Manchester, England. The primary object of the experiment was "to prove how far the widespread desire for shorter hours might be met without danger to the mechanical trades." (Mather, 1894, VIII.) Although no figures are given, the report states that when the output for the year 1893 on a forty-eight hour week schedule was compared with the average output of the previous six years (on fifty-four and fifty-three hour schedules), production was found to have increased. Selling prices were slightly lower during the experimental year so that the cost of wages in proportion to turnover rose 0.4 per cent. Oddly enough, however, a reduction in the cost of gas and electric lighting and wear and tear on machinery showed a saving of 0.4 per cent, exactly counterbalancing the debit from the increased cost of wages, so that the management came out even. Mr. Mather draws the following general conclusion, "We seem to have been working in harmony with a natural law instead of against it. . . The most economical production is attained by employing men only so long as they are at their best. When this stage is passed, there is no true economy in their continued work." (Mather, loc. cit., pp. 25-26).

The experience of the Salford Iron Works is particularly instructive since it shows the beneficial effect of the reduced weekly schedule to have been permanent. It is frequently pointed out that a reduction in hours may tempt employees to speed up their work, fearing lest their wages be reduced because of a lowered output. The general health of the workers must therefore be carefully watched for a considerable period after hours have been reduced. As we shall see further on a record of health insurance or of lost time will generally supply the desired information. That the success of the eight hour schedule at the Salford Iron Works was felt to be unequivocal, however, was expressed by Messrs. Mather and Platt in their reply to the inquiry by the United States Bureau of Labor asking whether at the end of eleven years, their works were still on an eight hour basis. The reply, dated May 24, 1904, stated that: "Our experience since the first year in which it (the eight hour system) was tried has fully borne out the conclusions then arrived at, and we are fully satisfied that as regards the comparison between eight and nine hours per day, the balance of advantage is in favor of the shorter period." (Goldmark, 1912, VIII, p. 141.)

The second experiment in reducing the length of the working day was made at the Engis Chemical Works near Liége, Belgium. The work of this company consisted in the reduction of zinc blend and the transformation of the liberated gases into sulphuric acid. The occupation was a distinctly dangerous one, the employees being exposed to poisonous gases and to extreme heat. Under the two-shift system and a working period of ten hours a day, the sick benefit fund showed a constant and alarming deficit. Moreover the workers, who had originally been recruited from a fairly vigorous and healthy stock showed an evident and rapidly increasing physical deterioration. The manager of the works, M. L. G. Fromont (1906, VIII), therefore determined to reorganize his labor force on a three-shift basis, thus reducing the work day to eight hours. The benefits resulting from the change are described most interestingly by Miss Goldmark (1912, loc. cit.). In less than six months after the beginning of the experiment "the workers had *equalled* in seven and one-half hours the previous output of ten hours, and the daily wage for eight hours' work equalled the wage previously earned in ten hours." The hourly output was ultimately so much increased that the eight hour day showed a 33.33 per cent. greater total output than had the ten hour day. That the strain of the increased output was not injuring the worker was shown by the progressive increase of receipts over expenditures in the sick benefit fund. Finally, the total cost of production fell 20 per cent. "Thus in the new organization of work technical perfection was not sacrificed nor neglected. The amount and quality of the output improved progressively, together with the moral and physical improvement of the labor force." (Goldmark, loc., cit., p. 149).

The third and most complete and painstaking study of the effects of shortening

INCREASE IN EFFICIENCY UNDER THE EIGHT HOUR DAY OF 233 PIECE WORKERS AT THE ZEISS OPTICAL WORKS, CLASSIFIED BY AGES.

(Ages were reckoned from April 1, 1900. Length of service reckoned according to years spent in the firm's employ after the eighteenth birthday.)

Ages	No. of Workmen	Average Ages	Average Length Service	Average Piece-Rate Earnings per Hour in Pf.		Ratio of Increase
				9-Hr. Day	8-Hr. Day	
22-25	34	23.5	5.5	55.3	65.2	100:117.9
25-30	69	27.3	7.9	62.2	72.6	100:116.7
30-35	69	32.2	10.1	65.1	74.8	100:114.9
35-40	40	37.7	12.7	60.6	70.2	100:115.8
Over 40	21	45.3	15.3	63.3	74.3	100:117.4
Total	233	31.6*	9.6†	61.9	71.9	100:116.2

*Maximum 53, minimum 22 years.
†Maximum 33, minimum 4 years.

the work day was made by Ernst Abbé at the well-known Zeiss Optical Works at Jena, Germany (Abbé, 1901, VIII). Abbé's work is now so familiar to students of industrial efficiency that in spite of its outstanding excellency and thoroughness, we need give it but brief mention. In 1900 the work day at the Zeiss Works was abruptly changed from nine to eight hours, as a result of a careful consideration of the success of a reduced work day at the Salford Iron Works and the Woolwich Arsenal Works in England. The experiment at the Zeiss Works was planned to run one year. In determining the effects of the shorter day, Abbé compared the earnings of piece workers for the year before and the year after the change in hours was made. To make this comparison strictly objective and to eliminate so far as possible all chance variations, only the output of workers who had been with the firm four years and who were over 22 years of age, was considered. Workers who showed more than 300 hours of lost time or whose health seemed below normal were likewise eliminated from the calculations. This left 233 workers and the increase in efficiency of this group under the eight hour day is best shown by the following table (Goldmark, 1912, VIII, p. 159).

Abbé recognized clearly the importance of discovering just where each individual's maximum lies, though he considered this problem essentially a matter of special investigation. From his own statistics and from other experiences in Germany and England he drew the general conclusion that for about three-fourths of the industrial workers of Germany a nine hour day was unnecessarily long for attaining the maximum output and eight hours was not too short. In the interest of economic development and German national efficiency he, therefore, made a recommendation which is considered radical in some quarters even to-day—the gradual reduction of the work day to eight hours for all German industries.

The English, Belgian and German experiences with a reduced work day have been widely corroborated both in this country (Note 11) and in Europe (Webb & Cox, 1891, VIII; Frankfurter & Goldmark, 1915, VIII). The most recent contribution to the problem is the work of the British Health of Munitions Workers Committee (Bull. U. S. Bureau of Labor Statistics, Nos. 221, 223 and 230,

COMPARISON OF RESULTS

Operation	Speeding up of Operation Possible	Reduction in Weekly Hours of Actual Work	Alteration in Total Output Effected
Men sizing	Throughout, and without limit	58.2 to 51.2 = 7.0	+22
Women turning fuse bodies	Throughout, to a limited extent	66.2 to 45.6 = 20.6	+ 9
Women milling a screw-thread	For a fifth of the total time taken	64.9 to 48.1 = 16.8	− 1
Youths boring top caps	Not at all	72.5 to 54.5 = 18.0	− 3

VIII). The committees' data were gathered under highly abnormal conditions but these very conditions presented a particularly favorable opportunity for studying such questions as overtime, and night work. The relation among British munition workers of the reduction in working time to output was studied in great detail by Dr. Vernon (Mem. 18, 1917, VIII). An improved output always appeared in cases where the speed of the operation was not dependent upon automatic regulation of the process by the machine. In a study of four separate operations involving varying degrees of this automatic element, Vernon found the alteration of output to fluctuate between +22 per cent. and —3 per cent. From the table on page 39 (Vernon, loc. cit., p. 9) "it will be seen that a reduction in the weekly hours of work varying from 7 to 20.6 in the different operations in no case produced more than an insignificant diminution of total output, whilst on an average it produced a distinct increase."

Dr. Kent's study of the unfavorable physiological effects of overtime adds little to our information on the subject for the reason that the individuals were unfortunately selected in favor of the outcome of the experiment. On page 38 (Kent, 1916, 2, VIII) there appears a "table showing output of a worker engaged during eight hours per day compared with that of three similar workers engaged during twelve hours per day; and also the output of workers before and after the abolition of overtime." The workers in this case were women engaged in winding bobbins. The tables show, briefly, that the output of the eight hour worker is greater by more than 8 per cent. than the average total output of the "three similar workers" working twelve hours per day for the first two weeks, and ten hours per day for the second two weeks of the experiment. A comparison of the eight hour worker (No. 14, a) with the "three similar workers" shows, however, that the former was a woman 32 years old who "had worked as a winder at the mill for about seventeen years" (p. 68), whereas the other three workers were girls of 16 and 21 years and, as their records show, relatively inexperienced winders. Overtime studies in general have shown that in the long run the system is uneconomical, both financially and physiologically. The higher wages demanded for overtime work and the loss in efficiency on the part of the workers form an obviously unpractical combination.

In deciding upon the proper length of the work day, both the nature of the operations and the capacity of individual workers must be considered. In cases where the work involves a variable human effort factor the physiological evidence strongly favors an eight hour limit. It should be borne in mind that even where original output is merely maintained or slightly decreased as a result of shortening the work day, the physiological gain to the workers' general health and the strengthening of their morale is of material benefit to the employer. The beneficial psychological effect upon the industrial workers of a voluntary shortening of the work day as compared with the compulsory shortening resulting from a walk-out can scarcely be overemphasized. Industrial workers as a class are frequently suspected of desiring practically an indefinite shortening of the work day. "If they get eight hours, they'll want six" is the alarmist's cry. It is certainly significant that in the only instance where the workers as a class have had a chance to express an opinion on the subject they have decided in favor of a universal eight hour day and against night work and overtime for women and minors (Nation, 1919, VIII). The economic outcome of such an arrangement will doubtless be questioned by some, but anyone who will trouble to read with an open mind the physiological evidence against too long hours, night work and overtime for women must feel that the men who planned such a radical industrial program were possessed of a profound wisdom and social vision.

II. Scientific Management

In an earlier section (p. 26) we have referred to Dr. Taylor's well-known efficiency studies. In his book on Scientific Management, Taylor (1911, VIII) states that his mathematical associate, Barth, discovered the law governing the tiring effect of heavy labor on a first-class man. "And the law is," says Taylor, "that for each given pull or push on the man's arm it is possible for the workman to be under load for only a definite percentage of the day." Just what this statement is intended

to convey is not clear. In the absence of any mathematical proof and all but the most fragmentary published data, we must simply accept Taylor's statement on faith. But we cannot accept the physiological criterion, "the tiring effect of the work on the man," which Taylor used to determine the presence of fatigue. And though we marvel at the increase in Schmidt's capacity for handling pig iron, we also wonder how well he lasted. So far as we can discover, this phase of scientific management has not received the attention that it deserves. True efficiency must be measured in terms of the maximum work that can be accomplished by an individual without the loss of his general health. In recent years scientific management has unfortunately developed along the lines of highly specialized "motion studies" (Gilbreth, 1912, VIII), the object of which has frequently been the attaining of a basis for a proper piece rate or bonus system. The psychological effect of having their motions timed has led many workers to believe that scientific management was merely a special sort of drive. And it is obvious enough that in the hands of an unscrupulous manager it might become exactly that. The labor unions, furthermore, very soon discovered that the principle of the bonus system is the principle of individual bargaining instead of union bargaining. Now, union bargaining has a deeper meaning than the mere formal negotiations involved in the arranging of a wage schedule. It implies the oversight of the individual contract and the power to demand that this contract conform to the wage schedule. In the bonus system the unions have thus faced the problem of coping with an almost infinite number of small and uncontrollable variations from schedule. A haunting fear of losing their solidarity has finally driven them to urge the adoption of legislation actually forbidding the practices of scientific management on government contracts. They have been so successful in securing the passage of the desired legislation that the carrying of a stop watch on a government contract is now considered as serious an offense as the carrying of any other concealed deadly weapon.

CONCLUSIONS

1. Muscular work may be carried on at such a rate that metabolites are removed at the same rate as energy is added to the muscle. Such a muscle attains a "fatigue level" (Hough) after which it is in dynamic equilibrium, and may, theoretically, continue to work indefinitely (Figs. 1 and 3).

2. Of the three general methods that have been proposed for studying muscular fatigue, that of Hough (1901, IV, 3) suggests the most promising direction for further theoretical and practical experimentation (Fig. 2).

3. The work of Cannon and his students has suggested a physiological basis for the psychological conception of "reservoirs of energy" (James). According to Cannon sympathetic stimulation followed by the secretion of adrenin favors muscular activity by releasing bound sugar from the liver (hyperglycemia), by accelerating the heart and increasing blood pressure, thus favoring circulatory irrigation. These results complicate the entire problem of fatigue. It is suggested that certain extreme conditions of accumulated fatigue may be the result of adrenin poisoning.

4. Central fatigue has been demonstrated in the case of afferent and connecting neurones, but the rôle of the nerve cell body in central fatigue is not clear. In the present state of knowledge, the question of mental work appears to lie beyond the scope of physiology.

5. The physiological demonstration of a varying energy level renders the commonly accepted correlation between output and fatigue extremely doubtful and probably invalid. Individual output may fall as a result of normal fatigue or it may rise as the result of some emotional stimulus. The latter, if protracted, may lead to nervous breakdown.

6. The correlation between output and accident distribution is not a simple one. Statistical studies of accidents and output in the same group of workers are urgently needed before a definite conclusion can be reached (Fig. 6).

7. The psycho-physiological laboratory methods for studying fatigue have yielded almost no practical results when applied under industrial conditions. The reasons appear to be: first, laboratory subjects and industrial subjects are absolutely incomparable units; second, a condition approaching industrial fatigue never occurs

in the laboratory; third, the possibility of abnormal conditions in which sensitivity is reversed, as in certain psycho-neuroses have largely been neglected; and fourth, tests have been prematurely introduced under factory conditions without adequate previous theoretical study.

8. The term "industrial fatigue" is at present loosely applied either to the daily and weekly weariness resulting from industrial work or to the condition of accumulating fatigue which merges insensibly with psycho-neuroses. It would seem more logical to restrict industrial fatigue to the former more popular meaning and designate the gradually accumulating fatigue in overdriven industrial workers as *industrial psycho-neurosis.*

NOTES

1. Mlle. Ioteyko's *La Fatigue* in Richet's *Dictionnaire de Physiologie* gives a comprehensive review of the physiological aspects of the subject up to 1903.

2. This reaction is usually written the other way, as the esterification process, not the ester hydrolysis. (For further theoretical details of both reactions see Knoblauch, loc. cit.).

3. A detailed account of the researches that have led to the modern views of energy exchange in muscular activity will be found in Fletcher and Hopkins' Croonian Lecture for 1917 (II).

4. By "normally" we mean in the absence of special excitement or other emotional stress. (See "The Varying Energy Level" below.)

5. The sensations of weariness or sleepiness which accompany the performance of work are frequently considered to be reliable criteria of fatigue. In referring to the uncertainty of such subjective test, Rivers (1908, VII, p. 2) says, "In the performance of mental work especially, decided sensations of fatigue may be experienced when the objective record shows that increasing and not decreasing amounts of work are being done; and there may be complete absence of any sensations of fatigue when the objective record shows that the work is falling off in quantity or in quality, or in both."

6. The working rate in many of the older experiments was

$$\frac{\text{Contraction}}{\text{Relaxation}} = \frac{1 \text{ sec.}}{1 \text{ sec.}}. \text{ This is usually written } \frac{C}{R}.$$

7. Hough (1901, II) has shown conclusively that in the case of a trained muscle, the staircase phenomenon does not appear; the muscle contracts to its full capacity the first time. We have consequently considered our ordinates H to represent the maximum contractions. It should be pointed out that the staircase phenomenon is by no means constant. Mosso (1890, I) found it to be either positive or negative, for no clearly discernible reason.

8. The larger question involving the efficiency, not of a single reacting muscle but of composite groups such as we actually utilize in our daily tasks, presents a very much more complicated problem which we shall consider later on in our discussion of industrial efficiency (p. 40).

9. Cannon's work has been criticized by Dr. G. N. Stewart, in a number of recent papers. (See especially Am. J. Physiol., 44, 542.)

10. Dr. Lee has apparently not considered the possibility of the injurious effects resulting from an emotional overstimulation. He says (p. 102, loc. cit.): "During the war emergency special efforts should be made to stimulate the patriotism of the workers, and they should be made to realize that they individually have an important part to play in the winning of the war and in helping to establish the rule of right and justice." On the other hand, Florence (loc. cit.) expresses the attitude of the British Health of Munitions Workers Committee when he says (p. 84, loc. cit.): "Patriotic enthusiasm, as Professor Loveday points out, will stimulate men to keep at work when they are convinced of its urgency even though they are unwell and really need a rest"; and again (Vernon, Mem. 7, p. 15): "Misguided efforts to stimulate workers to feverish activity in the supposed interests of the country are likely to be as damaging to the desired result as the cheers of partisans would be if they encouraged a long-distance runner to a futile sprint early in his race."

11. The report of the work conducted by the U. S. Public Health Service in the munitions factories of the United States has not yet been published in complete form. (See Lee, 1918, VIII.)

PART III: BIBLIOGRAPHY

In the following bibliography we have omitted all but a few scattered references to the problem of fatigue in connection with education. We have also made no attempt to include the fatigue of the sense organs. The text references indicate the author, year of publication and number of the division in the bibliography in which the article is listed. We have adopted the following classification of titles:

I. General Discussion of Fatigue
II. Muscular Work and Neuro-Muscular Fatigue
III. Mental Work and Central Fatigue
IV. Tests for Fatigue
  1. General Discussion
  2. Sensations of Fatigue
  3. Dynamometric Measurements
  4. Sensory Threshold Fatigue
  5. Reflexes
  6. Chemical Reactions
V. Rhythms and Variables
VI. Correlation between Mental and Non-Mental Activity.
VII. Pathological Conditions
VIII. Industrial Fatigue and Efficiency

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For special aspects of problems relating to scientific management and efficiency consult the Bibliographical Lists prepared by the Division of Bibliography, Library of Congress, especially No. 64.

TELEPHONE OPERATING: A STUDY OF ITS MEDICAL ASPECTS WITH STATISTICS OF SICKNESS DISABILITY REPORTS*

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NINE years' connection with the New England Telephone and Telegraph Co. have afforded the author most unusual opportunities both for studying telephone operating as an industry and for becoming acquainted with problems of personnel in telephone operating from the point of view of a physician.

The opportunities for study lie in examination of conditions in the telephone exchanges themselves; in the follow-up of special instances in which there is possibility of the presence of occupational disease; in the sifting of employees for admission to the school for telephone operators; in the re-sifting of those who have passed through the school before permanent placement in the exchanges; and in the analysis of individual problems involved in absences for ill health, in length of service, in dismissals, and in resignations from the service.

In taking advantage of the opportunity for studying the work in central telephone exchanges under all sorts of conditions, many problems of general hygiene have presented themselves. Consider, for example, the question of ventilation. At one time there was considerable enthusiasm on the part of a small group of people for solving the problem of ventilation by establishing ozone machines in the telephone exchanges. I was asked to investigate the value of the machines and later to convince these people of the findings. This was accomplished with the help of Professor Norton of the Massachusetts Institute of Technology. Samples of air were taken in a telephone exchange, both with the ozone machines in operation, and without, i.e., under the existing system of ventilation. These tests revealed the fact that the air in the exchange was good, and that the ozone machine had no effect whatever.

As is often the case, however, the incident gave opportunity for further experiment which was of real value. I had observed, in sitting before a telephone switchboard for a short time, during the busy hours when every position is filled, that the air between the operator and the board is poor. The switchboard is much higher than the operator's head, and she sits about two feet from it. Electric fans are arranged at frequent intervals at the top of the switchboard, at such an angle as to blow down in front of the operator and remove this air, but many girls, even in hot weather, object to the fans except for a very short while. We therefore took advantage at this time of the opportunity for having a test made of the air between the operators and the switchboard, with the result of discovering that a sample taken immediately in front of the operator contained more carbon dioxide after a fan had stirred up this air, than elsewhere in the exchange.

As a result, operators are now required periodically to stand at the board for from five to ten minutes at a time during the busy hours, while all the windows in the room are thrown open, and in this way, the bad air is removed.

The question of infectious diseases is also a problem of general hygiene to be considered in telephone operating. Throughout the exchanges an effort is made to prevent the spread of infectious diseases by having any employee, who has a disease of this nature in her household, stay away from work during the incubation period. She is paid for her lost time if she keeps herself from exposure by leaving home or if the patient is absolutely isolated. If she does not protect herself against infection, she is not paid. I have been interested to learn that boards of health, although prohibiting children from attending school if there is an infectious disease in the family, nevertheless permit an individual in the same family to work, even at an age when he is not beyond susceptibility to the same disease. The value

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of precautions is demonstrated by the infrequency of epidemics in the exchanges. One striking instance of bad results occurred when the precautions were neglected and several operators in a small exchange developed mumps. The trouble here was apparently due to an operator who worked during the incubation period, not realizing the importance of reporting to her chief operator the presence of the disease in her family. On one occasion, when diphtheria threatened one of the smaller exchanges, the operators were advised to have their susceptibilities tested by the Schick Test, and to take antitoxin if the results warranted it.

BENEFIT COMMITTEE

Another duty which I have assumed with great interest is the follow-up of all cases in which there is possibility of occupational disease. I have seldom found good evidence of occupation as the sole cause of any disordered condition found among telephone operators. The following case illustrates the value of thorough investigation. An operator had a persistent pain extending from the front of the ear down into the neck, always made worse when she wore her receiver. It was reported by an excellent general practioner and by an ear specialist, as an occupational disease, due to the pressure of the receiver. As the ear was in no way involved, disease of the ear, it seemed to me, should not be considered. I investigated an entire exchange of about 100 operators to see whether, in general, receivers were worn low enough to bring pressure on the spot where the pain in this case started. I found that such was the case among a small proportion of operators, although a receiver, accurately worn, is too high to bring pressure on the spot in question. I then sent the patient to another physician, who discovered that she had an infected tooth which had caused an enlargement of the gland in front of the ear. This was, of course, painful, and would stand no pressure. The removal of the tooth cleared up the occupational disease.

The possibility of brass poisoning of the skin and through the skin is a common belief among operators and apparently among some physicians. The plugs used at the switchboard to connect the subscribers' lines have brass tips, and at the base, a band of brass about one-quarter inch in width. The brass tip and band are supposed to be the cause of much trouble, although it is poor technique to pick up the plug by the brass tip because it necessitates shifting before the plug can be used. If, through carelessness, the cord or plug is used when it has become frayed or rough, there may result a mechanical irritation of the skin which might easily be the beginning of a dermatitis.

Generally, the so-called brass poison case is one of pus infection. There has, however, been one notable exception. A girl with a long-standing eczema of so severe a type that her skin had become permanently thickened and discolored, had a dermatitis of her fingers. A noted dermatologist concluded that the brass encountered in handling the plug was the irritant, although he admitted that he could find in the literature no record of skin poisoning from brass.

Occasionally, a dermatitis develops due to a preparation of acetone which is used by special clerks to remove fine lines painted on the switchboard. A cloth over a stick should be used, but sometimes a girl uses her fingers instead.

Stretching to reach the high multiple on the switchboard, which is often unfavorably commented on, has always seemed to me to be of real value in overcoming the discomfort of the constant sitting. The fact that the girl has to use both hands and arms is also of great advantage, both from the point of view of exercise and of dexterity with the left hand. It does occasionally happen, however, that pain in the lower right quadrant of the abdomen, due to chronic appendicitis, is increased by stretching, and is therefore attributed to stretching. There have also been a few cases of pain under the scapula, which I believe were probably due to subscapular bursitis. Such a bursitis, if not due to stretching, is unquestionably increased by it and a girl so affected should stop work until cured.

Accidents are practically never connected with telephone operating itself, but are usually due to blows from elevator or locker doors, and to falls.

While there are repeated opportunities for follow-up work in general and in special problems of this kind, the chief value of the author's nine years' experience in

telephone work has been the cumulative information acquired by observation, from a medical point of view, of large numbers of persons over a long period of time. During the last four years I have personally interviewed over 3500 operators, and have examined about 3000 operators in training before they were sent out to the different exchanges. The points of contact with the regular employees are through (1) the exchanges, (2) the Benefit Committee.

EXCHANGES

The particular part of the New England Telephone and Telegraph Co., with which I am connected is the Traffic Department of the Boston Metropolitan Division, where, in the fifty-two offices, are employed about 4000 operators, including chief operators and supervisors. Of this group, all employees who are absent over six days have to see me before returning to work, that I may judge whether they are able to work. If any employee has a poor daily attendance, and we include in this group any girl who has to stay out every month because of difficulty with menstruation, she is sent to me for advice. Any operator doing poor work and seeming to be in poor condition, even though she has excellent attendance and makes no complaint, should be sent to me by her chief operator. Any operator who wants medical advice—which may be simply to ask whom she should consult for any trouble that she has—is at liberty to come to me at any time. She may make the appointment through her chief operator, or may come without asking for an appointment.

BENEFIT COMMITTEE

The telephone company has a sick benefit plan, by which all operators who have been with the company two years or over, receive benefit; the payment, which is determined according to the length of service, beginning at the end of the first week. For from two to five years' service, the operator is entitled to four weeks' full pay and nine weeks' half-pay; five to ten years' service, thirteen weeks' full pay and thirteen weeks' half-pay; over ten years' service, thirteen weeks' full pay, thirty-nine weeks' half-pay. There is a Sickness Disability Report made out for every employee of the telephone company, who is obliged to be out for ill health over six days. This is forwarded to the Benefit Committee of the company to which she belongs. If her length of service is two years or more, her name is entered on the Committee's pay roll. If under two years, she is granted a leave of absence.

Any employee who is on the Benefit Committee's pay roll and is able to be out of doors, is asked to report to me for examination. If I am convinced she is unable to work, I may ask her to report to me as often as I think best until she is able to return to work. If I find she needs the attention of a specialist, or think she is not receiving proper medical attention, or that the case is not properly diagnosed, I have the privilege of sending her to a specialist or expert diagnostician, previously agreed upon by the Benefit Committee and myself, and the Benefit Committee pays the bill. Also, if I find no reason why the girl should not be back at work, and she and her physician think she is not able to work, I may send her to one of these physicians for examination. If he finds no reason why she should not be at work, the benefit is stopped, although her return to work is decided by her own physician.

The physician for the telephone company not only has the responsibility for the employees of the company, but is associated with the principal of the school for telephone operators, who is also the employment manager. The principal, Miss Mary E. Harrington, a woman of great experience and unusual ability in judging people, has herself managed a large exchange, and has studied and developed methods of training operators since the school was started, over ten years ago. Through our combined studies, essential points—physical and mental—which are the minimum requirements for the work, have been defined as a working basis.

In looking over the blanks used by many employers of labor, it has seemed to us that an elaborate, artificial scheme is too often used, without sufficiently definite application to the purpose. Our idea has been, having worked with large numbers over a long period, to profit by our mistakes and put all our attention on certain points which seem to be essential and which can be insisted upon. There are, of course, many things which we would like

to change, but before which we are powerless, such, for example, are the extremes in fashion so sure to be present in any large group of women, especially between the ages of 17 and 25. Very high heels unquestionably must have, sooner or later, a bad effect upon most girls, but to insist that a large group of girls shall wear unfashionable low heels and proper shoes has seemed to us impracticable.

PHYSICAL REQUIREMENTS

There are certain physical requirements which are demanded by the principal of the school for telephone operators and her assistants before accepting a student. The applicant must have a sitting height of 32 inches and an arm stretch of 60 inches in order to reach the high multiples of the switchboard. Her standing height and weight are taken as an estimate of her general condition. It is seldom, however, that disproportion of weight and height is sufficiently extreme to disqualify a girl for work. An examination of the eyes is very necessary for two reasons. If the applicant has absolutely no vision in one eye, it is impossible for her to do the work, because at a switchboard she cannot turn her head far enough to see on the side on which she has no vision. A girl who has been trained and has been unfortunate enough to lose the sight of one eye may get on very well, but we find it too great a strain for a beginner. If an operator is astigmatic, the row of jacks—small round holes—are probably a cause of eye-strain because of a constant effort to keep the holes and rows symmetrical. Close work, requiring the use of the muscles of accommodation, is really very slight. Any student who is subject to headache or who cannot read the fine type with either eye, is sent for an expert eye examination for which the company pays. The girl pays for her own glasses.

In examining a student her hemoglobin is tested as an indication of her general condition, particularly important in girls from 17 to 25, which is practically the age limit for beginners. No student would be excluded from the service because her hemoglobin was low, but she might be held over if it were extremely low, and, in order to avoid unnecessary fatigue, she would always be advised to do something to improve it.

Disturbances of the menstrual function, headaches and fainting are given consideration, both as an indication of the nervous condition of the individual and in order to impress on the girl that if she has to lose much time for any of these conditions, she can not be kept in the service. The opportunity is taken to advise students who have trouble of means of correction.

The ears are tested, and an applicant must have practically normal hearing in both ears because she not only has to use one ear for the receiver, but she must also be able to hear with the other anything that is said by her supervisor. Old middle ear disease with little impairment of hearing does not disqualify a girl for the work. We have, however, an expert examination to safeguard the girl, because if anything happens to her ears which incapacitates her for telephone work she has lost time which might have been better spent in some other employment not requiring such constant use of the ears.

The throat is inspected and any question of diseased tonsils, frequent colds, or trouble with the voice is settled by sending the student to a specialist and getting his diagnosis and advice.

The student is carefully questioned as to family history in regard to tuberculosis and as to her personal history for frequent colds or trouble with the lungs. If there is any questionable history whatsoever she is sent to a lung specialist for examination. If the girl is in good condition herself, a history of tuberculosis in the family or evidence of an old inactive process in her own lungs, would not debar her from the work.

The heart is examined, and if there is evidence of valvular disease the girl is allowed to enter the service unless there is some indication of lack of compensation. Before dropping a student for any cardiac disease, the advice of an expert is obtained.

The standard of nervous endurance and nervous adaptability of a girl for telephone work is the most difficult problem we have. We at one time asked Dr. William Healy about the desirability of using psychological tests. He was sure that certain tests could be worked out and made definite suggestions in this direction, but he doubted if a better percentage of re-

sults could be obtained than the employment manager already had. She has never fallen below 75 per cent. of successes among her admissions during the last four or five years, and generally has about 80 per cent. Dr. Healy's opinion is that no mechanical tests are of more value than good common sense, assuming, of course, that good sense is equivalent to a sound psychology supplemented by knowledge of the special subject and experience in successful application.

Professor Hugo Münsterberg once applied some psychological tests to a group of students in the school for telephone operators, which he has reported in his book, *Psychology and Industrial Efficiency*. He made the mistake, I believe, of approaching the problem with a too definite idea that memory is a more important factor than it is in the opinion of workers of long experience. The time interval between the reception and the use of a number is necessarily short, and the aids to memory so well provided by markings on the switchboard that memory without doubt plays a very unimportant part in telephone operating. Concentration, accuracy, self-control, and co-ordination are the most important factors. Of the students on whom the Münsterberg tests were made, 75 per cent. actually made good, while according to the tests, only 50 per cent. should have done so. Making good means passing the examinations of the telephone school for operators, remaining in the service, and reaching the standards set for the term of service.

The fine methods developed for training students before they are placed in the exchanges are a factor, not only economic for the industry, but also contributory to the health of the individual and to the morale of the force. This training goes on after the student leaves the school, and is accomplished by allowing the student operator to listen in with experienced operators, to operate herself under the supervisors when the incoming calls are comparatively few, and finally to be placed between good experienced operators. It is estimated that it takes at least a year and a half for the average girl to develop the highest standard of skill, for which adequate time and experience is allowed in this way.

The choice of students must be necessity be governed by the number and quality of the applicants, and this varies enormously in different sections of the country. Boston is probably exceptional, as there are always some hundreds of desirable applicants on the waiting list. With such a list to choose from, it is possible to select girls with at least one year of high school training and with good natural ability.

STATISTICAL RECORDS

The mass facts of interest in relation to the health problems of regular employees are shown through the very careful statistical records which the telephone companies make up once in six months regarding length of service, resignations and their causes, employees who have been dropped from service with the causes of dismissal, daily absentee records and any unusual conditions which may affect the whole working force. The 1918 report, for example, will probably not be as valuable in a study of this kind because of the abnormal conditions, i.e., the many resignations to enter government work, and the influenza epidemic, which enormously increased the number of daily absentees. During the height of the epidemic, from a daily average absentee record of 250, the number rose to 1080 in one day in the Boston Metropolitan District.

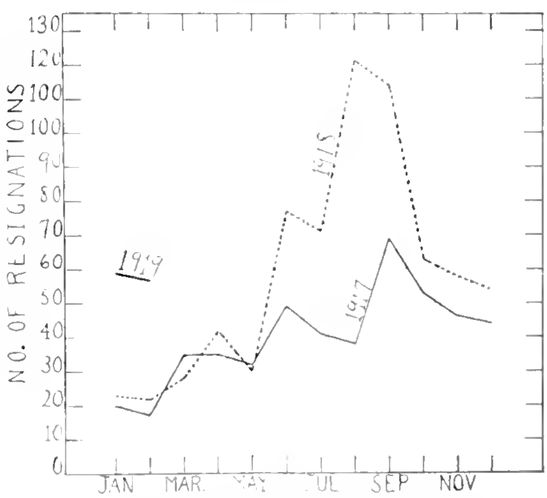

Fig. 1.—Curves showing the increase in the number of resignations of telephone operators in the Metropolitan Division of the New England Telephone and Telegraph Co. in 1918 over those in 1917.

Figure 1 shows the increase in resignations for 1918 over 1917, and Figure 2,

TABLE I

Average Length of Service and Pereentage of Resignations, 1910 to 1918, Inclusive, of Employees in the Traffic Department of the New England Telephone & Telegraph Co., and in the Metropolitan Division of this Company.

Statistics Compiled in February	Average Number Months' Serviee, N. E.	Average Number Months' Service, Met. Div.	Per Cent Resignations N. E.	Per Cent Resignations Met. Div.	Per Cent Resignations Due to Ill Health, N. E.	Per Cent Resignations Due to Ill Health, Met. Div.
1910	36.3	41.4				
1911	39.8	44.0	28.4	20.4	....	....
1912	41.2	46.1	25.6	17.0	4.0	2.6
1913	40.9	45.9	21.0	15.0	4.2	4.2
1914	44.7	48.5	14.0	10.4	2.4	1.6
1915	51.0	53.7	12.0	7.0	1.8	1.0
1916	51.5	56.2	11.2	6.4	1.4	1.0
1917	53.5	56.6	13.0	8.6	1.4	1.6
1918*	60.3	64.8	25.2	16.8	3.0	2.2

*Statistics for 1918 are the August instead of the February statistics.

the abnormal absentee record due to influenza. The second rise in the curve, which shows the second increase in influenza cases, covers a longer period of time and affects more people but the individual absence is generally shorter.

LENGTH OF SERVICE

Table I shows the average length of service of employees in the New England Telephone and Telegraph Company and in the Metropolitan Division of this company in months, for nine successive years, the percentage of resignations, and the percentage of employees resigning for ill health. The number resigning for ill health is known to be over- rather than under-estimated, because ill health is often a simpler excuse for the individual to give than the real cause, which may range from resignation for marriage to other employment.

Table I shows not only an increasing length of service, but also, even in 1910, an unusually long period of service for women employees. Women in industry change their work much more frequently than men, probably largely due to the fact that the great majority do not expect to stay permanently in the industrial world, but to marry. The percentage of resignations in 1918 again shows the abnormal conditions of that year.

STUDIES FROM SICKNESS DISABILITY REPORTS

In presenting the effects of the work on the different parts of the body which may be subject to strain in telephone operating, I have taken up the cases which have come to me personally and have compared my figures with the larger group of cases in the report of the Benefit Committee of the New England company, with the figures in the reports of the benefit committees of other large companies in the country, and with the figures in the reports of the benefit committees of the whole Bell system. I have chosen the 1917 reports for study, because at the time of writing the 1918 reports are not completed, and, as I have pointed out before, the 1917 figures are more valuable for study because of the abnormal conditions of 1918.

My group of cases includes employees of all lengths of service from a few months to twenty years. Out of an average force for 1917 of 3882, a large group, 37.3 per cent., had had a service of over five years. The following figures show the length of service of my group—employees of the Metropolitan Division of the New England Telephone and Telegraph Co.—on August 29, 1917:

	Less than 1 Yr. Service	1-2 Yrs.' Service	2-5 Yrs.' Service	Over 5 Yrs.' Service	Total
No. of employees	653	575	1203	1451	3882
Per cent employees	16.8	14.8	30.9	37.3	....

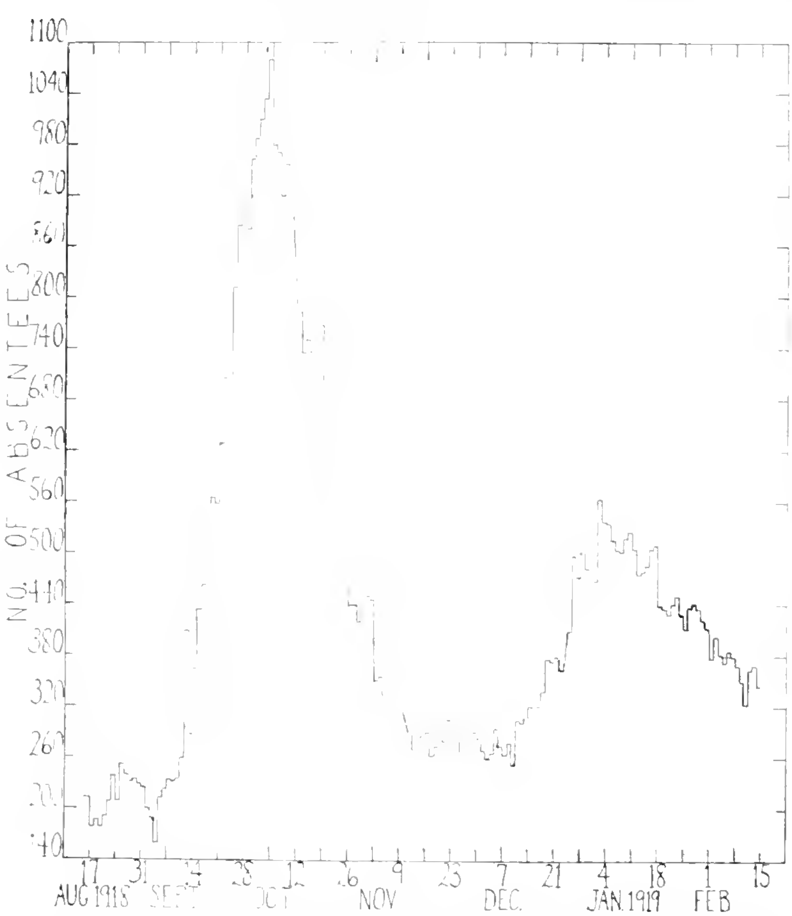

FIG. 2.—Curve showing the abnormal daily absentee record among telephone operators in the Metropolitan Division of the New England Telephone and Telegraph Co., during the influenza epidemic of 1918.

The cases tabulated in the report of the Benefit Committees include only employees who have been with the various companies two years and more. In evaluating the statistics of the Benefit Committees' reports, it must be remembered that the diagnoses in these cases are made by a large group of physicians of very varying ability. The classification is made largely by lay people on the Benefit Committees. This method of classification affects especially the group of ill-defined cases called *general debility*. These may be classed by one committee under the head of *neurasthenia;* by another under the head of *tuberculosis*, a physician having designated the cases as "pretubercular"; and by still another committee under the head of *acute gastritis*, because vomiting happened to be the first manifestation of illness.

In 1917, 1384 girls, out of a total of 3882, employees of the Traffic Department of the Boston Metropolitan Division, visited the staff physician. Table II shows the statistics of illness of employees of the large telephone companies of the United States, and of the total Bell system, which includes these six large companies and twenty-one other companies.

DISEASES OF THE EYE

A girl with astigmatism which has not been discovered and corrected before she goes to work, is very likely, as I have said before, to have eye-strain from looking at the jacks. There has been a good deal of comment made by people unfamiliar with

TABLE II

Statistics of Illness of Employees of Telephone Companies in the United States in 1917

Company	Average Number Female Employees Dec. 31, 1917	Total Number Female Employees Eligible for Sickness Disability, Oct. 1, 1917	Number Receiving Sickness Disability	Cases per 1000 Employees per Annum Eligible for Sickness Disability
N. E. Tel. & Tel. Co	10,177	6,431	1,640	255.0
N. Y. Tel. Co	20,165	11,323	3,541	312.8
Bell Tel. Co. of Penn	12,448	4,890	1,253	256.2
Chicago Tel. Co	10,438	4,733	2,126	449.2
Pacific Tel. & Tel. Co	9,960	4,654	931	200.0
Total Bell Tel. System	127,484	55,277	15,000	271.4

the switchboard, on the strain of flashing lights. The lights are of fractional candle-power, and are covered with thick ground glass which is sometimes colored. Any strain to the eyes from these lights would be impossible, but the fact that the flashing of a light indicates to the operator that there is an impatient subscriber does have an effect upon her general nervous system.

In 1917 thirty-one girls in my group had some trouble with their eyes. Iritis and acute conjunctivitis make up the acute inflammations. In my experience there has never been a syphilitic iritis or a gonorrheal conjunctivitis. In the statistics compiled by the Benefit Committees there were probably no refractive cases, because absence for this cause alone would not be long enough to be reported.

The following figures show the disorders of the eyes occurring among the operators of the Boston Metropolitan Division in 1917:

	Length of Service				Total
	0–1 Yr.	1–2 Yrs.	2–5 Yrs.	5 Yrs.	
Acute Inflammation	..	2	9	1	12
Errors of Refraction	4	2	12	..	18
Meibomian Cyst	..	..		1	1
					31

Table III gives the statistics of eye diseases of the operators of the large telephone companies of the United States and of the total Bell system.

DISEASES OF THE EAR

The receiver, which is held over the ear by a steel band passing up over the head, sometimes causes excoriation of the external ear. This condition is especially likely to occur in a beginner who thinks she must have the receiver very tight over the ear in order to hear, but it is rarely found

TABLE III

Eye Diseases

Company	No. Eye Diseases	Cases per 1000 Employees per Annum Eligible for Sickness Disability
N. E. Tel. & Tel. Co.	15	2.3
New York Tel. Co.	22	1.9
Bell Tel. Co. of Penn.	14	2.9
Chicago Tel. Co.	26	5.5
Pacific Tel. & Tel. Co.	10	2.1
Total Bell Tel. System	146	2.6

among experienced telephone operators.

During my nine years' service there has been one interesting case of hysterical deafness. The girl in question had a loud noise in her ear, which, for a time, apparently caused complete deafness. After careful examination by a neurologist and by an aurist, the diagnosis of hysterical deafness was made. She soon recovered the hearing of one ear, but when last heard from insisted that she could not hear in the other.

A curious nervous condition which has been noted in a very few students is that of inability to hear with the receiver in place, although there is no disease or defect of the ear. In these cases mechanical relief was attempted by change of position and instrument but without results.

There have been astonishingly few employees who have had sufficient deafness to oblige them to give up the work. In general, attention is so trained that experienced operators almost invariably think that their hearing has become more acute.

There were thirty-three cases of ear trouble in my group during 1917. The following figures give the details:

	Length of Service				Total
	0 1 Yr.	1-2 Yr.	2-5 Yr.	5 Yr.	
Acute Middle Ear Inflammation	2	3	7	11	23
Chronic Middle Ear Inflammation	1	..	1	4	6
Disease of External Ear and Canal	1	1	1	1	4
					33

Table IV gives the statistics of the ear diseases occurring among the operators of the large telephone companies of the United States and of the total Bell system.

TABLE IV
Ear Diseases

Company	No. Ear Diseases	Cases per 1000 Employees per Annum Eligible for Sickness Disability
N. E. Tel. & Tel. Co.	25	3.9
New York Tel. Co.	43	3.8
Bell Tel. Co. of Penn.	14	2.9
Chicago Tel. Co.	24	5.1
Pacific Tel. & Tel. Co.	9	1.9
Total Bell Tel. System	167	3.0

DISEASES OF THE NOSE AND THROAT

Diseases of the larynx are the most important division of this group from the point of view of the effect of the industry. There have been three cases diagnosed as singer's nodes. One of these cleared up in so short a time that a consulting laryngologist decided that the case was one of acute inflammation rather than of singer's nodes. The second case was that of a girl who had been with the company a very short time, not more than two or three months. This girl was obliged to resign and seek other occupation, as with a throat so delicate she was clearly not fitted for telephone work. In the third case the girl had been operating for over five years when she began to get hoarse. She was out on sick leave for two months and when she returned was given clerical work. She still has a very husky voice, although it is more than two years since she stopped telephone operating. Mrs. May Sleeper Ruggles, a vocal music teacher to whom this girl was sent by her physician, called attention to the fact that, since only a few short sentences are used, and these used repeatedly, the voice is confined in telephone operating to a very limited range. To counteract this evil she advised practising scales. This advice, together with suggestions for forward placement of the voice, I have passed on to many girls with poor voices. It would, perhaps, be better to insist that girls with chronic laryngitis do some other work, but there have been no other cases which seemed sufficiently severe to warrant this.

The hysterical aphonias have been very interesting. Some years ago in two different exchanges there occurred a number of cases. In both places the conditions were very similar. The series of cases was started with loss of voice due to acute laryngitis in a girl, who, because she felt well, was allowed to stay in the exchange and do clerical work. Following this, four or five girls suffered loss of voice with no physical cause which could be discovered by throat specialists. Two cases in this series occurred in the same exchange and were quite unusual. One was so extreme that it was diagnosed at the Massachusetts General Hospital as a psychosis, and it seemed to me probable that it was due to occupation. For this reason a change of occupation was advised and the patient resigned. Several months later she came to ask another trial, because she could find no work she liked as well. Having learned in the meantime that this girl had lost her voice before she ever did telephone work, I decided to give her another trial. This happened over five years ago and she has had no trouble with her voice since. The other case was of a girl of rather pronounced hysterical type. When she returned to work after recovery from her loss of voice she feared she would have trouble unless her position at the board was changed. Several times afterward she had trouble for a short time, an hour or two, and once was sent immediately to me. When she came in to speak to me her voice was all right, and she told me this story. She had gone into the retiring-room and a friend had said to her, "Don't go near Miss Smith, she has lost her voice and you'll lose yours." In spite of this warning, she went over to speak to Miss Smith, but could not say a word. She has had no trouble for two or three years.

The small number of these cases—and in telephone work cases of this kind cannot escape notice—raises the question whether they are really out of proportion among telephone operators. Some light might be thrown upon this matter if the occupations of all the patients with hysterical aphonia could be studied in a large clinic. It is now the rule in the telephone company to send home a girl who loses her voice, and the difficulty of a group of cases has never been repeated.

In my group, during the year 1917, there were 349 cases of trouble with the nose, throat and larynx. Many of these patients had had operations on the nose which seemed to have been ill-advised, and on the

TABLE V

Diseases of the Nose and Throat, Boston Metropolitan Division

	Length of Service				Total	
	0-1 Yr.	1-2 Yrs.	2-5 Yrs.	5 Yrs.		
Operations on Nose	2	7	9	7	25	
Acute Choryza	12	12	28	24	76	
Chronic Catarrhal Inflammation	1	3	11	13	28	
Atrophic Rhinitis		2	6	4	12	
Tonsillitis, Acute	14	14	46	40	114	39.7
Tonsillitis, Chronic, Operated	3	6	15	9	33	per
Tonsillitis, Chronic, not Operated	1	1	4	1	7	1000
Laryngitis, Acute	5	10	14	13	42	
Laryngitis, Chronic	1	.	1	1	3	
Aphonia	1	3	2	3	9	
					349 (89.9 per 1000)	

whole to have caused more discomfort than the ill-advised tonsillectomies. There have been, on the other hand, many operations for diseased tonsils after which there has been a great improvement in the health of the patients. It is my custom to advise girls to secure the advice of two specialists before submitting to an operation on the nose.

Atrophic rhinitis is a disease which often necessitates resignation from the telephone service because the odor is so intolerable and the disease usually so slow of cure.

The table made up from the reports of the Benefit Committees shows only acute and chronic operative tonsillitis. My percentages exceed the percentages in these reports because they include more types of disease, and also a certain number of girls asking advice, who were not out on disability.

Unfortunately, the Benefit Committees have not included laryngitis in their special diseases for tabulation. Probably the number of cases sufficiently severe to cause absence for over one week was small, and therefore seemed unimportant.

Table V summarizes all the cases of disease of the nose and throat in the Boston Metropolitan group.

Table VI gives the general statistics of tonsillitis among operators of the large telephone companies of the United States and of the total Bell system.

TABLE VI

Tonsillitis

Company	No. of Cases	Cases per 1000 Employees per Annum Eligible for Sickness Disability
N. E. Tel. & Tel. Co.	219	34.1
New York Tel. Co.	316	27.9
Bell Tel. Co. of Penn.	138	28.2
Chicago Tel. Co.	325	68.6
Pacific Tel. & Tel. Co.	136	29.3
Total Bell Tel. System	1,773	32.1

DIGESTIVE DISTURBANCES

I believe that with all girls between the ages of 18 and 25 digestive disturbances are very common, due to the fact that there

TABLE VII

Gastro-Intestinal Disturbances, Boston Metropolitan Division

	Length of Service				Total
	0-1 Yr.	1-2 Yrs.	2-5 Yrs.	5 Yrs.	
Appendicitis	2	3	1	4	10
Appendicitis, with Operation	4	1	16	15	39
Gastric Ulcer	1	....	.	.	1
Cholecystitis, with Operation	..	....	.	1	1
Cholecystitis, without Operation		..	.	2	2
Ptosis of Abdominal Organs		.	1	5	6
Indigestion, including Constipation	6	11	42	31	90
					149

is great irregularity in eating, in care of the bowels, and often very unwise choice of food. It has to be remembered that telephone service must be available night and day, Sundays and holidays, and that the service has great variation in different hours of the day. For this reason, a certain number of operators have to begin work at very early hours and these girls are apt to do without breakfast and to eat lunches, very likely with tea or coffee, in the morning and in the afternoon relief and in the lunch period. It is, however, true that girls with the most desirable hours do the same thing, and that some girls choose the early hours because they like them. The early hour work should, however, be recognized as a condition of this industry which may contribute to digestive disturbances.

Table VII summarizes the gastro-intestinal disturbances of employees of the Boston Metropolitan District in 1917. In my opinion, gastric ulcer is probably more common than appears in this table, but it is seldom that satisfactory diagnoses are sent in by physicians attending the girls in their homes.

TABLE VIII
Digestive Disturbances, Including Diseases of the Stomach and Appendicitis

Company	No. of Cases	Cases per 1000 Employees per Annum Eligible for Sickness Disability
N. E. Tel. & Tel. Co	198	30.8
New York Tel. Co	298	26.4
Bell Tel. Co. of Penn.	110	22.5
Chicago Tel. Co	122	25.8
Pacific Tel. & Tel. Co	78	16.7
Total Bell Tel. System	1346	24.4

Table VIII gives the statistics of digestive disturbances occurring among the operators in the large telephone companies of the United States and the total Bell system.

TUBERCULOSIS

In looking over the reports of the different companies, it is noticeable that the percentage of tuberculosis in the New England company is 7.6 as against 4.7 per cent. or less in other companies. This seems a difference so great as to require explanation. It is probably both a question of diagnosis and of classification. In the Metropolitan Division, for example, which represents over one-third of the New England company, it is the custom to send for an expert examination any girl who, from no apparent cause, has lost weight or is feeling tired. This naturally leads to the discovery of early tuberculosis and of so-called pre-tubercular cases. These have, as a matter of fact, been classified as tuberculosis in the New England committee's group and no doubt account for the large percentage. It should be noticed too that the New England company in spite of the larger percentage of cases, has, probably as a result of early diagnosis, a low death rate of 4 per cent., as against 8 per cent. of the whole Bell system.

TABLE IX
Tuberculosis, Boston Metropolitan Division

	Length of Service				Total
	0-1 Yr.	1-2 Yrs.	2-5 Yrs.	5 Yrs.	
No. Cases	1	3	11	6	22
No. Deaths	..	2	2		1

TABLE X
Tuberculosis

Company	Number of Cases	Cases per 1000 Employees per Annum Eligible for Sickness Disability	Number of Deaths
N. E. Tel. & Tel. Co	49	7.6	2
New York Tel. Co	48	4.2	7
Bell Tel. Co. of Penn	22	4.5	5
Chicago Tel. Co	18	3.8	2
Pacific Tel. & Tel. Co	22	1.7	0
Total Bell Tel. System	256	1.6	21

In 1917, 163 girls in the Boston Metropolitan Division were sent to a specialist for examination of the lungs. Of these, twenty-two had active trouble, twenty-six had enlarged bronchial glands, forty-four had an old inactive process, and the rest were negative. There were four deaths, two of whom had a service of less than two years and so do not appear in the report of the Benefit Committee of the New England company. This was an unusual number of deaths, two being the greatest in any one year up to 1917, but I have an impression that in 1918 there was an increase both in the number of cases and in the deaths.

Table IX gives the tuberculosis statistics for the Boston Metropolitan District for 1917.

Table X gives the general statistics of tuberculosis among operators in the large telephone companies of the United States and in the total Bell system.

NERVOUS DISEASES

The classification of this group of cases is very difficult, because telephone operators have shown very few organic diseases of the nervous system and the symptoms which do occur are so largely subjective that it is difficult to know just where the emphasis should be placed. A study of the statistics of different Benefit Committees' reports shows a very marked variance in the percentage of cases. Neurasthenia, which is the diagnosis adopted, is evidently used to include all types of nervous fatigue. The typical neurasthenic is generally unfitted for telephone work. A large majority of the operators in this group whom I see are cases of simple fatigue. A small percentage have some marked symptom, such as insomnia, emotional disturbances, tremors, or occasionally chorea.

During my whole service I have known of but five cases of insanity; one of these was a very pessimistic girl, who enjoyed talking of suicide and imagining horrors but who did not have delusions. For this reason, I have ventured to doubt the diagnosis of insanity which was made by a good psychiatrist, who however, interviewed the patient only once. Two of the insane patients have recovered. One of these, a girl with acute melancholia, had had sufficient family trouble to upset a person of much better poise, and has, I believe, permanently recovered. The other patient may, I fear, have other attacks, as she is a girl of poor judgment and has a family history of insanity. The remaining two insane patients probably have little hope of recovery: one is a case of dementia praecox, and is the second member of her family to have the disease: the other patient has shown very little improvement although under hospital care for three years.

Table XI summarizes the cases of nervous disabilities in the Boston Metropolitan District in 1917.

TABLE XI
Nervous Disabilities, Boston Metropolitan Division

	Length of Service				Total
	0-1 Yr	1-2 Yrs	2-5 Yrs.	5 Yrs.	
Fatigue, without Definite Symptoms	17	16	65	84	182
Fatigue, with Definite Symptoms				2	2
Insanity			1		1
Neuralgia		2	2		4
Neuritis, Pain with Tenderness	1	1	1		3
Facial Paralysis			1		1
Occupational Neurosis			1		1
Neurasthenia		1	1		2
Hysteria	3		13	2	18
					214 (55.1 per 1000)

Table XII gives the statistics of nervous disability among operators in the large telephone companies of the United States and in the total Bell system.

As Group 2 (fatigue with definite symptoms) in my table is unusually small, I think possibly some cases classified as simple fatigue should belong here—cases which were probably seen late when they did not present the more severe symptoms.

From the standpoint of the hygiene of

TABLE XII

Nervous Disability, Including Neuralgia and Neurasthenia

Company	No. of Cases	Cases per 1000 Employees per Annum Eligible for Sickness Disability
N. E. Tel. & Tel. Co. . .	129	20.1
New York Tel. Co	631	55.8
Bell Tel. Co. of Penn. . .	202	11.3
Chicago Tel. Co	140	29.6
Pacific Tel. & Tel. Co .	90	19.3
Total Bell Tel. System .	1845	33.4

telephone operating, the group which I have classified as simple fatigue seems to me the most important and the most difficult to study. As the length of service increases, the percentage of these cases increases. At the end of two years when an employee is entitled to sickness disability payment, the percentage, which has been about the same for the first two years, nearly doubles, and it also increases somewhat in operators of over five years' service. In this group of cases there are a certain number of girls who are excellent workers, reliable, and in every way valuable employees, but who have not the nervous energy to work fifty weeks in the year. I doubt if these girls form 1 per cent. of the whole group. Another group is made up of girls who have very poor endurance; they give up for every ill, and so have a poor daily attendance, but both work and attendance are not quite bad enough to cause them to be dropped from the service. Such girls always have a long convalescence from any real illness, and the excuse is given of a "run down condition." As long as they can afford to remain idle there seems to be no incentive to induce them to go to work. I find, as they report to me weekly, that they either make no progress or that they lose in weight, become more anemic, have no appetite, and sleep poorly. Improvement often follows going back to work.

Another type in this group of cases is the girl who has "gone stale." I suppose no person with brains and with imagination escapes this, but some have it worse than others. It is most common among the operators who have worked five to ten years. Some conditions which I think may account for this are, first, reaching the age of 23 to 30 without marrying; second, the lack of ability or ambition to advance; third, home conditions or temperament which make recreation difficult. In the really tired-out group, there is a large number who have excessive family obligations and a few who burn the candle at both ends in order to have a good time.

Hysterias are mostly of the ordinary type; lack of control and semi-unconsciousness. The one case of occupational neurosis in this group is another instance in which the subsequent history disproves the diagnosis. The girl in question had a pain in her neck which was diagnosed after a careful examination by a neurologist as a neurosis due to pressure of the receiver. After a rest the pain disappeared, and when the girl returned she was given clerical work to do. After a year of clerical work, which required neither the wearing of receiver or transmitter, the patient was again in poor condition and the old pain returned. No definite cause for the pain was ever discovered, but it was found that she had very trying home conditions, the burden of which she had to bear alone.

As will appear from the records of cases, diseases attributable to the work alone are very rare. It is a question whether it will ever be possible to eliminate the percentage of girls who have not the kind and the amount of endurance to do telephone work, or to persuade those who have tried it and are unsuited, to do something else. The greatest cause of nervous strain lies in the inevitable irritations to be found in every personnel. It is hardly possible to arrange a force so that no employee shall come in contact with an uncongenial superior, or so that absolute justice shall be meted out to every individual.

The ordinary methods for the measuring of fatigue, applicable to work which is largely mechanical, are not of value in telephone operating, because there is such a large human element on all sides. The *A* operator, who answers the subscriber's signal, for example, may be stimulated or emotionally upset by the tone of voice of the subscriber, or by her supervisor, or by the *B* operator, to whom she passes the call. The *B* operator, on the other hand, does not have the subscriber to deal with, but she does have the supervisor and the *A*

operator. An operator with no fatigue may, on one occasion, have very many errors from a temporary emotional disturbance; at another time, the same operator may be stimulated by some emergency to do very good work even when fatigued.

Chief operators and supervisors, too, are very human and have to stand the brunt of the criticisms of both the subscribers and of the officials of the company.

In telephone operating it is necessary to have what are known as service tests. In no other way can the standard of service be kept up and justice be done to the public and to the operators. These tests may not always have been wisely used in the past and may have constituted a source of nervous strain, but with the present methods very little misuse is possible.

The amount of concentration needed to do good telephone work is, of course, a consumer of energy, but on the other hand concentration unquestionably develops nervous control and nervous endurance. I doubt very much if it is ever the chief cause of nervous breakdown.

The careful preliminary training which teaches an operator what to do on all occasions, the arrangement of the switchboard for good team work, and the fact that on the whole the work does not hold over, are the greatest safeguards against nervous strain.

The monotony which must come to all individuals who work for compensation should, I think, be corrected during the worker's free time; the problem of the employer should be to see that there is sufficient free time to counteract any strain.

In telephone operating the hours of work vary because of the necessity of a twenty-four hour service and because of the great variation in the amount of business at different hours of the day. Advantage in time is given to those who work after 7 P. M. There are four types of service: the straight day, the divided hour, the short hour, and the all night. Every period of work is broken by a fifteen minute relief for operators and a twenty minute relief for the supervisory force. In the city offices the day is eight and three-quarters hours, out of which are taken two fifteen minute reliefs and three-quarters of an hour for lunch, leaving seven and one-half hours' labor. Lunch can be bought at cost on the premises, saving time and making it possible to spend more time out of doors. In the out of town exchanges one hour for lunch is given, because the girls prefer to go home for lunch, but the hours for labor are the same, seven and one-half. The divided hour duty, or "split trick" as it is called, has a morning and evening service, i.e., one service of three hours and one of four, or two services of three and one-half hours each. Out of each service is taken a fifteen minute relief, leaving six and one-half hours for labor. These hours must be arranged so as to give not less than eleven and one-half hours between stopping work at night and beginning in the morning. The short hour trick is either 4 to 10 P. M., or 5 to 11 P. M., with a half-hour relief, making five and one-half hours' labor. The all-night operators' hours are from 11 P. M. to 7 A. M., with an hour and a half relief, making six and one-half hours' labor.

Very careful studies have been made by skilled engineers, watching conditions in an exchange and listening in on positions, to note every possible variation in an individual's work in order to determine what proportion of time an operator can work well, i.e., render the best service to the public with the fewest possible errors and with the least possible physical and nervous strain. In this way standards have been established which are technically called *loads*. These vary for different types of operators. The *A* and *B* operators are occupied during the busiest hours 50 to 85 per cent. of the time. This variation is necessary to allow for sudden emergencies. For short periods the work often falls below 50 per cent. of time occupied, but it is found that if it stays much below 50 per cent. for any length of time the service is invariably poorer. There is, however, probably no group of workers who, confronted with an emergency, respond with more enthusiasm and ability than telephone operators. This has been instanced again and again in Boston and in the vicinity in great public emergencies, such as the Chelsea and Salem fires and the influenza epidemic, and there are from day to day in the exchanges countless smaller emergencies for which preparation is impossible and where individual and group morale are tested to the full.

BOOK REVIEWS

Italian Women in Industry. A Study of Conditions in New York City. By Louise C. Odencrantz. Cloth. Price, $1.50 net. Pp. 345. New York: Russell Sage Foundation, 1919.

This book reports an intensive study of a section of our Italian population in New York City. The work was begun in 1911 and finished in 1913. During this time 1095 women wage-earners were interviewed, 2727 calls being made; the living conditions of 544 families were recorded and a study made of the weekly budgets of 147 women, not living at home. A careful record was kept of the total annual income and the expenditures of forty-eight of the families. The investigators also followed the women into their places of work, visiting 271 manufacturing establishments out of the 734 employing the group of women studied. All but twenty-seven of the women lived in the Italian districts below Fourteenth Street, and over three-fourths, 772, were in the lower west side colony in the neighborhood of 28 Macdougal Street.

The occupations followed by the group were:

Manufacturing	1027
Trade and Transportation	55
Professional service	7
Domestic and personal service	6

Seventy-five industries were represented in the manufacturing group, by far the largest number consisting of the manufacture of various articles of clothing. Paper box making, candy making, laundry work, flower and feather making and tobacco trade are also included, so that the list is fairly comprehensive.

The studies made cover the following phases of the lives of these women:

1. The Women and Their Families.
2. Occupations of Italian Women at Work.
3. The Work Places of Italian Women.
4. Hours of Work.
5. What Seasons Mean to the Worker.
6. The Pay Envelope.
7. Ups and Downs of the Family Budget.
8. The Woman Who Does Not Live at Home.
9. Education and Training.
10. Readjustment.

The picture one obtains from this report of hopeless repetitive work, of uncertain tenure of positions from which no advance is possible, and of impossible living conditions cannot fail to act as a severe indictment of our methods of handling labor. The women studied represent one-third of the working force in the establishments investigated, and the conditions they are facing must also affect women from other countries. Many of the women studied had been in the United States since childhood and had had no opportunity for real Americanization. No facts were elicited showing fundamental defectiveness for citizenship in these Italian women. The facts showed that they had become rather helpless parts of a great machine, the movements of which were far beyond their comprehension.

A conspicuous feature brought out by the investigations is the almost complete lack of anything approaching health supervision. Not only are these women placed in a position from which it is impossible for them to rise, but their health is so far jeopardized that they, themselves or their children, cannot fail to become a source of unemployable individuals.

The remedy lies, first, in education through trade unions, clubs, settlements, evening schools and, most important of all, in the efforts of far-seeing employers. The uncertainties of employment and the opportunity to find suitable work should be safeguarded through employment bureaus such as we may expect to have through the United States Employment Service. Considered simply as labor, with no question of the humanitarian side of the matter, one cannot but feel that this report pictures these Italian women as a certain liability in the labor market. If we could but realize that they are a valuable and perishable economic asset, the gain to the country would be great.—*Katherine R. Drinker.*

Physical and Occupational Re-Education of the Maimed. By Jean Camus with the collaboration of A. Nyns, Bourrillon, F. Terrien, E. Fontane, Nôve-Josserand, Bourget, Boureau, P. Larue, A. de Mazières, E. Leroux, P. De Cabaussel, E. Voron, J. Nanot, P. Lindemans, Belot, Private, H. Nepper, and C. Vallée. Authorized translation by W. F. Castle, Surgeon, R. N., with articles on British institutions by Sir Arthur Pearson, Bart., Margaret Sale, and Dudley B. Myers. Cloth. Price, $2.00. Pp. xi., 195, with illustrations. New York: William Wood & Company, 1919.

This is a brief and non-technical account of the efforts toward the re-education of disabled soldiers now being made in France, Belgium and England. Its chief value lies in the sensible and courageous view it presents of a task, large and perhaps discouraging. Thus, at the outset the statement is made that physio-therapy must not be prescribed like quinine, but always psychotherapy must go with it. And so, through the entire book, one is reminded that in the disabled soldier we have a new type of individual, who must be led into new work by the most adroit means at the disposal of the educator.

Brief accounts summarize various types of work, such as agricultural work, basket-making, silk production, dairy work, mechanical training, etc.

It is regrettable that the numerous pictures which accompany the text are frequently so indistinct as to be of no value.—*Cecil K. Drinker.*

BOOKS RECEIVED

Dispensaries, Their Management and Development. A Book for Administrators, Public Health Workers, and All Interested in Better Medical Service for the People. By Michael M. Davis, Jr., Ph.D., Director of the Boston Dispensary, and Andrew R. Warner, M.D., Superintendent of Lakeside Hospital, Cleveland. Cloth. Price $2.25. Pp. 438, with illustrations. New York: The Macmillan Company, 1918.

Colloid Chemistry. An Introduction with Some Practical Applications. By Jerome Alexander, M.Sc., Chairman, Special Committee on Colloids, Division of Chemistry and Chemical Technology, National Research Council, Member Amer. Institute Chemical Engineers. Cloth. Price $1.00 net. Pp. 90, with illustrations. New York: D. Van Nostrand Company, 1919.

Creative Impulse in Industry. A Proposition for Educators. By Helen Marot. Cloth. Price $1.50. Pp. 146. New York: E. P. Dutton & Company, 1918.

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USE OF ARMY GAS MASKS IN INDUSTRIES*

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INTRODUCTION

THE use of the army gas masks in the industries needs no advertising campaign. More than three million men have been trained in their use and have been taught that masks will completely protect them from all the poisonous gases used in warfare. These soldiers, on returning to their former occupations, will demand masks for protection against similar and probably against all toxic and suffocating gases with which they may have to contend. Herein lies a real source of danger. The simple army type of mask, while applicable to most toxic gases in low concentrations, such as occur around ordinary industrial operations, gives no protection against carbon monoxide and very little against ammonia, nor can the masks be used in atmospheres deficient in oxygen. Self-contained oxygen breathing apparatus must always be used in the latter case, and in the former, until a suitable absorbent is developed for protection against carbon monoxide. Special canisters have been developed for absorbing ammonia and in all probability a canister for carbon monoxide will also be available in the near future. It is the purpose of this paper to state briefly the conditions under which the present army mask may be used in the industries, and to describe some modification in canister filling for special gases when the standard filling is inadequate.

DESCRIPTION OF ARMY GAS MASKS

Mouthpiece Type

The Box Respirator, shown in Plate 1 and Figure 1, consists of a facepiece or mask for controlling the source of air entering the lungs, connected by a flexible hose to a box or canister containing granular chemicals which absorb certain impurities from the air drawn through them.

The facepiece is formed by pleating up a single piece of rubberized fabric, which is impervious to gas, in such a way as to form a hood, along the edge of which is sewn a smooth binding band corresponding in appearance and function to a hatband. This band fits the face along two meridian lines intersecting approximately at the temples, the first extending across the forehead just below the hair, the second down the sides of the face and under the chin just in front of the Adam's apple. Three openings are cut in the facepiece, two for the eyepieces set in metallic frames, and a third opposite the mouth for the angle tube through which breathing takes place. Special care is exercised in

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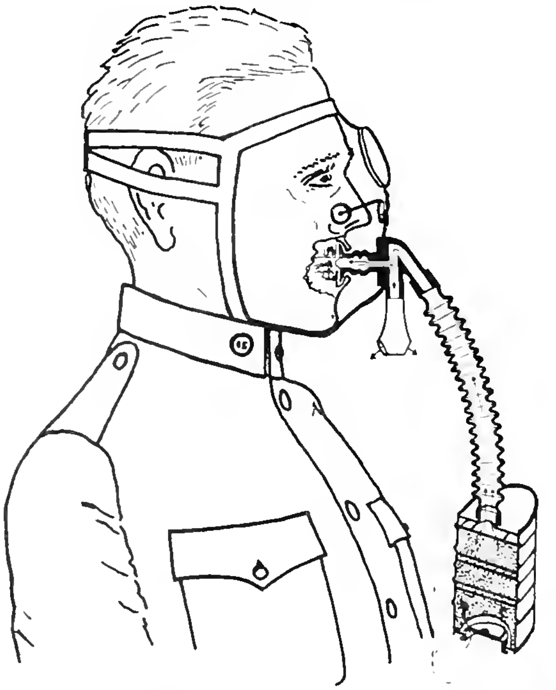

FIG. 1.—Cross section of U. S. Army gas mask, mouthpiece type.

PLATE 1—Photograph of U. S. Army gas mask, mouthpiece type.

fastening these metallic parts to the facepiece fabric to insure a rugged, gas-tight attachment.

Mention should be made of the eyepiece material, known as "triplex glass," which consists of two layers of glass cemented together by a layer of transparent celluloid. While it is possible to crack the glass in such an eyepiece by a blow which would completely shatter one made from ordinary glass, even under these conditions the celluloid layer remains intact, usually preserving the gas-tightness in the mounting, and, more important still, the danger from flying fragments of glass is practically eliminated due to the high degree of adhesion between the glass and the celluloid.

The angle tube, an aluminum die casting, which passes through the other opening in the facepiece, to which it is attached by a clamping nut, is in effect a T-fitting or three-way connection, with two of the three openings on the outside and the other on the inside of the facepiece. A rubber mouthpiece slips over the flattened opening of the angle tube inside the mask and is held in the mouth at all times, greater security against the leak of gas being secured by a baffle flange, about three-eighths of an inch wide, filling in the space between the lips and teeth. To the other two openings of the angle tube are attached the hose leading to the canister and the exhalation or flutter valve. Breathing is still further controlled by a nose clip which compels taking the air supply from the canister through the mouthpiece.

Exhalation, as has just been indicated, is by a special valve rather than back through the canister. There are several reasons for this:

(a) The resistance to respiration is much reduced.

(b) The re-breathing of expired air contaminated with carbon dioxide and low in oxygen content is largely eliminated. This also prevents drawing additional air through the canister to make up for the oxygen deficiency in the re-breathed air, thus prolonging the life of the canister.

(c) The mouthpiece in this type of mask produces excessive salivation, which, if not drained through the exhalation valve, would be carried into the canister, to the deterioration of the absorbent, and would cause an excessive increase in breathing resistance.

(d) The deterioration of the absorbent from moisture in the expired air is eliminated.

While these advantages of the exhalation valve are very real, it should be pointed out that such a valve has a potential source of great danger. If it fails to close promptly and tightly at the end of each expiration, the wearer is in serious danger of being gassed. Fortunately, several types of exhalation valve have been developed which, when properly mounted and guarded, will continue to function successfully for long periods. Under no circumstances, however, should the exhalation valve be removed from its mounting by an inexperienced person or the mask worn with the exhalation valve guard removed. The valve should be tested for leakage at frequent intervals, and replaced at regular intervals depending on the conditions of service.

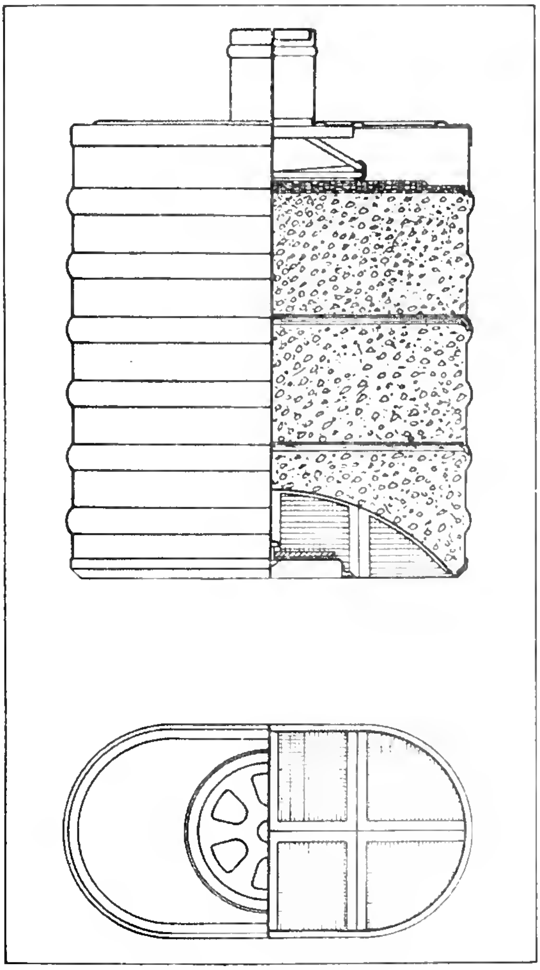

Fig. 2.—Cross section of standard U. S. Army canister.

Plate 2—Photograph of U. S. Army gas mask, Tissot type.

The absorbent medium is contained in the canister, a sectional drawing of which is shown in Figure 2. The canister is a box of tin plate having an oval cross section of 10 square inches, and a height of $5\frac{1}{2}$ inches. This container is filled with a mixture of absorbent material screened approximately 6-14 mesh. The material consists of an intimate mixture of special grades of charcoal and soda-lime, which constitutes a practically universal absorbent for the toxic gases used in warfare. Attention is called, however, to the fact that many of the gases met with in commercial use, such as, for instance, ammonia or carbon monoxide, are not taken up successfully by the mixture, and that no canister should be used except against the gases that it is designed to absorb.

The air enters the canister through a disc valve at the bottom, immediately over which is a screen dome for the purpose of allowing the air current to spread out at once over the entire cross section of the canister. The air current is then passed up through the absorbent mixture packed directly on top of this dome, and is drawn out through a seven-eighths inch nozzle located centrally on the top of the canister. There is a clear space of approximately one-half inch over the entire cross section

of the canister, to allow the air currents to converge without excessive resistance to the nozzle. In this space is located the packing spring, which, acting on a screen at the top of the mixture, holds the latter under a compression of approximately 40 pounds. Located at the top and at third points in the height of the mixture are cotton pads for the removal of dust and certain smokes existing in relatively large particulate form.

This type of canister and filling has a resistance to flow of from 3½ to 4 inches of water column when 85 liters of air per minute are passing through it.

Tissot Type

The Tissot type mask is shown in Plate 2. It differs from the mouthpiece type in that the mouthpiece and the nose clip are eliminated, and consequently the wearer can breathe through the mouth or through the nose. The inhaled air enters the mask from two tubes which discharge directly under the eyepieces and allow the air to sweep across them. This practically prevents moisture from condensing on the eyepiece, so that vision is not clouded as it is in the mouthpiece type. The facepiece is made of a rubber material, covered with stockinette on the outside. It has sufficient stiffness to prevent collapse on the face during inhalation.

The canister is the same as that used on the mouthpiece type of mask.

Superiority of Tissot Type Mask

The latest type of army Tissot mask is superior to the mouthpiece mask and should be preferable for industrial use where comfort to the wearer, visual acuity, and ability to do continuous work over a period of several hours are essential requirements. The mask must fit the face very closely, otherwise leakage will occur. In the latest designs this leakage is less than 25 c.c. per minute, in a well-fitted mask.

Since this 25 c.c. is diluted with from 6 to 30 liters of air per minute it does not inconvenience the wearer until the concentration becomes relatively high.

Although leakage through the facepiece of a mouthpiece type of mask does not affect the throat and lungs, it does irritate the eyes even more readily than in the Tissot mask, as the accumulated gas is not swept out by breathing. In fact it is this eye irritation from leakage that determines in many cases the maximum concentration in which a gas mask can be worn. For example, 0.5 to 1 per cent. phosgene is the maximum percentage of this gas in which a man can remain with even the best type of mask because leakage occurs, although the canister itself offers complete protection against proportions as high as 5 per cent.

A Tissot facepiece affords more protection to the eyes than any of the goggles that are usually sold with mouthpiece respirators, and gives much less trouble from dimming.

Many of the standard mouthpiece type of army gas masks will no doubt find their way into the industries. For intermittent and emergency use, in periods of one hour or less, the discomforts incident to the mouthpiece and nose clip can be endured and this type of mask will doubtless find considerable use. Manufacturers placing new respirators on the market should adopt the latest Tissot type as it greatly increases the efficiency of the worker and can be worn for extended periods of time in comparative comfort.

The Standard Army Canister

The army canister, containing 42 cubic inches of a mixture of charcoal and soda-lime, is designed to give protection against all the different gases used in warfare. Maximum protection against individual gases is therefore sacrificed to a considerable extent. However, it provides fairly good protection against a number of gases, as shown in the following table:

Gas	Life of Canister in Minutes
Benzol	14
Carbon bisulphide	17
Chlorine	13
Hydrocyanic acid	10
Hydrogen sulphide	97
Nitrogen peroxide	15+
Sulphur dioxide	16
Carbon tetrachloride	7
Gasoline vapor	10
*Aniline vapor	1410
Arsenic trichloride	13
*Benzyl bromide	470
*Benzyl chloride	300+
Chloracetone	50
Chloracetyl chloride	29
Chlorpicrin	12
Cyanogen bromide	150
*Dichlorbenzylbromide	3600+
*Dichlorethylsulphide	1980
*Dimethylsulphate	250

Gas	Life of Canister in Minutes
Ethyl chloride	10
Hydrogen chloride	37
Perchlormethylchlorformate	17
Perchlormethylmercaptan	5
Phosgene	24
Sulphur dichloride	17
Sulphur monochloride	15
Thiophosgene	20
*Xylyl bromide	470

*Tests made with saturated vapor at 25 C.

These tests were made at a concentration of 1 per cent. gas in air by volume and at a flow of 32 liters per minute, which corresponds to a man working moderately hard. In lower concentrations and under the condition of less work, the life is proportionately longer. The cotton wadding pads in the army canister serve as filters and remove irritating liquid and solid particles such as are formed on spraying silicon, titanium or tin tetrachlorides into air containing water vapor. Very finely divided particles, such as tobacco smoke or sulphur trioxide smoke, are not completely removed. The degree of penetration increases with the velocity of flow through the filter. The standard army canister provides poor protection against ammonia fumes and no protection against carbon monoxide. It must not be used around blast furnaces, gas producers, illuminating or natural gas, nor in coal mines after explosions or fires, as carbon monoxide is a constituent of the gases present in these places.

Special Canister Fillings for Specific Gases

It is, of course, obvious that the standard army mixture of 60 per cent. charcoal and 40 per cent. soda-lime does not furnish the maximum protection against such gases as are absorbed by one component only, as, for example, carbon tetrachloride, which is absorbed by the charcoal only or sulphur dioxide, which is taken up principally by the soda-lime. Hence, for industrial purposes it is best to design the canister filling for the specific gas in which it is to be used. An all-charcoal canister should be used for gasoline vapor, benzol, carbon bisulphide, carbon tetrachloride, chlorpicrin, thiophosgene, ethyl chloride, aniline vapor and similar compounds that do not react with soda-lime.

An all-soda-lime canister is recommended for hydrocyanic acid, hydrogen chloride, hydrogen sulphide, sulphur dioxide, carbon dioxide and other acid gases. The mixture canister is best for phosgene and chlorine, as the charcoal not only absorbs these gases but acts as a catalyst in forming hydrochloric acid, which is in turn absorbed by the soda-lime.

Ammonia fumes require a special chemical absorbent such as *kupramite*, which was developed at the American University Experiment Station. This special ammonia canister furnishes complete protection against 2 per cent. ammonia for periods of five to seven hours; owing to skin irritation a man cannot endure a higher concentration than 2 per cent.

INDUSTRIAL DEMAND FOR GAS MASKS

The Chemical Warfare Service of the army has received many inquiries regarding the use of army gas masks for all sorts of purposes, varying from protecting workmen charging quicksilver retorts, to alleviating the lachrymatory difficulties encountered in peeling onions.

Many of these demands are for purposes for which the army type mask is absolutely worthless, either because the toxic gas is not removed by the absorbents in the canister or because there is not sufficient oxygen in the atmosphere to support life, even though the toxic constituent is removed. Typical demands of this class have come from telephone companies who have to send workmen into underground conduits containing leaky gas mains; from by-product coke companies, for men engaged around the ovens and in the by-product recovery plant; from iron and steel companies, for protecting workmen from blast furnace gas on the furnace top, and while making repairs on stoves and flues; from gas producer and water gas installation companies for protecting against carbon monoxide; from petroleum companies for the use of men entering storage tanks and tank cars containing gasoline vapors; and for coal mine operators for protection against carbon monoxide formed after mine fires and explosions. In most of the above cases the poisonous constituent is carbon monoxide, which is not removed by the present army gas mask and even when a suitable carbon monoxide mask is developed (as no

doubt will be done in the near future), its use will be restricted in general to places that have a fair degree of ventilation, such as on the outside and top of blast furnaces and stoves. The oxygen breathing apparatus will always have to be used for entering a stove or flue filled with gas.

Another large industrial demand emanates from the numerous ammonia refrigeration plants. The various special masks and helmets now on the market for use in ammonia fumes are either cumbersome or inefficient. For protection against ammonia fumes acid on pumice or other absorbent medium has been successfully used in low concentration (less than 1 per cent.). At higher concentrations irritating fumes are produced and the inspired air becomes uncomfortably hot. The chemical and soda-lime absorbents of the standard army gas mask will remove low concentrations only (0.1 per cent. and less) and are soon exhausted. To fill this need for a good ammonia mask the *kupramite* absorbent was developed.

The Chemical Warfare Service has received through the Bureau of Mines a number of inquiries from smelters for gas masks for protection against sulphur dioxide and arsenical dust. Several standard army masks were furnished to the Anaconda Copper Mining Company at Butte, Mont., where they were used successfully by iron workers in making repairs on a Cottrell treater, which even though it was shut off from the roaster while the work was in progress contained so much sulphur dioxide that unprotected men could not enter. The sulphur dioxide content was between 1 and 2 per cent. A standard army canister containing 60 per cent. charcoal and 40 per cent. soda-lime was used. An all-soda-lime canister would have had a much longer life as the charcoal is of no value in removing sulphur dioxide.

An all-soda-lime canister with the army mask was found very useful by the U. S. Department of Agriculture, in connection with fumigating fruit trees and warehouses with hydrocyanic acid gas. This type of mask has satisfied similar requirements for protection against acid vapors and gases, such as hydrochloric acid and oxides of nitrogen, in the manufacture of explosives and chemicals.

Masks with special all-charcoal canisters have been found useful in various industries where volatile organic solvents are distilled. Charcoal is the best absorbent for carbon tetrachloride, carbon bisulphide, benzol, aniline oil and like vapors.

Probably the largest commercial use of the army mask with the standard war gas canister is in the manufacture of chlorine, sulphur chloride, and bleaching powder; and in industries using these products, such as chlorination plants, paper mills, rubber factories, etc.

SELECTION OF RESPIRATOR, GAS MASK OR OXYGEN BREATHING APPARATUS

The selection of the proper kind of protective appliance for irrespirable atmospheres should never be made without the advice of an expert, who has investigated the conditions under which the appliance is to be used. In general, respiratory apparatus may be divided into the following three classes, viz.:

1. Respirators of the simple "pig-snout" type for protection against solid and liquid particles.
2. Gas masks as developed for use in warfare.
3. Oxygen or air breathing apparatus.

The simple dust respirators are cheap and more or less useful in dusty atmospheres, and, when they contain a moist sponge, afford some protection against very dilute chemical fumes. None of them are comfortable to wear and most workmen tie handkerchiefs over their mouths and noses in preference to respirators. It is really unbearable to breathe through most of these devices for any length of time, while working. The wet sponge is irritating, and the breathing resistance due to the very small area of filtering medium is very high.

An efficient dust protector with low breathing resistance can be made by attaching a large felt or paper filter of at least 100 square inches filtering area to a Tissot mask facepiece. By increasing the filtering area, complete protection can be obtained against the very finest particles, and, if necessary, protection against toxic gases can also be obtained by a suitable combination of canister and filter.

The army type gas mask like the dust respirator is a filtering appliance only. It provides no oxygen and is limited to use in air containing low concentrations of

poisonous gases. The absorbents in the canister must be properly chosen for the gas in which it is to be used. As stated above, gas and dust protection can be combined in the same gas mask.

Oxygen breathing apparatus and air helmets are necessary in low oxygen atmospheres, in places where the percentage of toxic gas exceeds 1 to 5 per cent. (depending on the gas in question) and, for the present, wherever carbon monoxide is encountered.

HUMAN HEALTH AND THE AMERICAN ENGINEER*

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A YEAR ago on the Pacific Ocean, during a journey homeward from Russia, China and Japan, some one remarked that our position, which was then near the Aleutian Islands, was one of the most lonesome places to be found on the globe. A man whose acquaintance I had made on the voyage replied: "That is why I like it; it's a good place to stand off and look at the world." Then followed a conversation which I shall long remember. We talked about the world as if we were somewhere aloof. We spoke of the ways in which the oceans were being spanned—by steamship lines, cables, perhaps by aeroplane service; of the war and the ways in which the countries were being drawn together in their fight against the common enemy, Prussianism, of the ways in which the hearts of the world were being bound together by the Red Cross; of the ways in which even the diseases of mankind were common property; of the influence which the little marmot dying of plague in far-away Siberia had upon the death-rate of New Orleans and of cities in India and South America. Sanitation suddenly loomed up as a great world problem; public health included the whole human race. I had thought of these things before, as we all have, but this time the ideas became real and personal.

And then we spoke of the opportunities for Americans and especially for American engineers in foreign countries. We asked ourselves what is going to be America's contribution toward the solution of this world-wide problem of human health. And that is the question which I desire to bring to your attention at this time. It might have been a hard question to answer a year ago, but to-day the answer is clear.

It is interesting to look at the world's history and see what the different nations have contributed to the ever-present problem of health. Even the words we use are monuments which commemorate past efforts.

When we speak of *health* it is natural for us English-speaking people to use the old Anglo Saxon word "haelth." We also use variations of this old word. We say a man is "hale and hearty." *Hygiene* comes from the Greek word for health. When we use it to indicate those phases of health which are somewhat closely and intimately related to the human body—we speak often of personal hygiene—we are logically following the old ideas of the Greeks who placed great emphasis on physique, personal beauty, prowess and endurance. *Sanitation* comes from the Latin, and when we use it, as we do, in speaking of the healthfulness of man's environment, we are paying tribute to the works of the old Romans—to their great aqueducts and sewers, their public baths and their well-paved and well-kept streets.

But hygiene and sanitation did not drive disease from Greece and Rome. Malaria held both nations captive. Pestilence walked the earth in spite of public baths and sewers and physical exercise. Physicians practiced their arts in vain. It was recognized that diseases came from without, but as long as they were regarded as demons people had no means of defense. To such an audience as this it is unnecessary to recite the changes in medical beliefs which have taken place in the intervening centuries, but we recall with ut-

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most satisfaction and profound gratitude, that it was from France that we learned the true nature of the invisible enemies which attack man from without, it was in France that Louis Pasteur lived and died. He was every inch a scientist and every inch a Frenchman. While his country lay bruised and bleeding from the brutalities of the Germans, perpetrated in 1870 just as now, he laid the foundations of bacteriology and a preventive medicine which is bound to save more human lives than will be lost in this terrible war. Pasteur made the whole world debtor to France.

Since Pasteur's time we have been living in an age of scientific exploration and the guiding torch has been found in the hands of first one nation and then another. At one time it was in England, with a Lister, showing how surgery may be robbed of its attendant dangers, then it was in Germany, then in America, then in Italy, then in far off Japan. It has been a wonderfully rich and profitable exploration. Disease after disease has yielded up its secrets and while there is much left to learn, the victory over the communicable diseases is already won, because now we know how to fight successfully. History will record the triumph of preventive medicine as dating from the last quarter of the nineteenth century.

But I believe that the historians of the future will also record this year, 1918, as the beginning of another new era in human health, an era of achievement. The year 1918 has shown that it is possible to do things, and that, I believe, is going to be America's contribution to the health problem of the world—the *spirit of accomplishment*. That constructive spirit, that instinct for planning, for utilizing resources, for looking ahead, for organization, for doing large things in large ways is what we mean when we use the word *engineering*. I do not say that the coming era is to be that of the engineer, because we often use this word in a technical way, and the engineer personally will be no more important than the men of the other professions, but in the larger sense the coming era is to be the one of dynamics, of engineering achievement in relation to the health and the comfort of the common people.

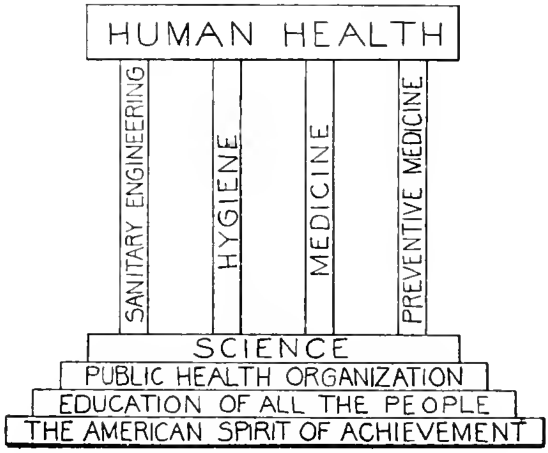

FIG. 1.—The Basis of Human Health.

Human health is based on four arts and we may indicate them by four columns, as shown in Figure 1.

Speaking as a sanitary engineer, it is my desire at this time to show how sanitary engineering is interlocked with the other arts for the maintenance of human health, and how in common with the other arts it rests upon science, upon organization, upon education and upon the American spirit of accomplishment, reborn in 1917-18.

The Great War found this country unprepared, but the energy and speed which have been put into the work of preparation and equipment have astonished not only our enemies and our allies, but ourselves. The great shipyards, the ammunition factories, the factories for producing ordnance and all sorts of military and naval supplies, the cantonments and the cities for housing workers have sprung up in a night and have been developed on a scale almost beyond our comprehension. The work has not been limited to direct war activities, although much of it has been dominated by them. The spirit of achievement is abroad in the land.

This spirit has included sanitation. We have known for many years that mosquitoes could be conquered by drainage, oiling and other measures, but this year we have gone ahead and done this work and driven out mosquitoes. The regions of the cantonments and the great factories have in fact been safeguarded from malaria. We have long known and we have talked much about city planning and housing, but this year we have gone ahead and laid out the

new cities and built the new houses on scientific principles. It is needless to multiply illustrations for we have all recognized this constructive spirit in matters relating to human health. Money has been spent more freely than the nation can ordinarily afford, but we must not suffer this spirit of achievement to die out after victory has brought peace.

Another result of the war has been to widen popular knowledge in regard to hygiene and sanitation. Our great democratic army is being trained not only how to fight, but how to keep well. The minor arts of hygiene as they relate to individuals are being effectively learned for the first time by millions of our young men. Examples of sanitary practice are being seen by these men in their army life, and they will never be forgotten. Finally within the last few months we have seen our universities turned into war colleges, and it is with great satisfaction that we note that one of the courses of study prescribed for upward of a hundred thousand young men who are being prepared to be officers is Hygiene and Sanitation. The syllabus for this course, prepared by a committee of sanitarians and recently announced by Dr. Richard C. Maclaurin, the Educational Director for Colleges, is broad and comprehensive, and the instruction in the application of modern science to the maintenance of health cannot fail to have an important influence on millions of lives. This universal instruction of our youth in methods of right living must be continued in all our schools and colleges after the war.

When we consider our public health organization, considered as a whole, we must admit that it has not stood the test. It is evidently inadequate, and needs radical revision. Taken separately, most of the various units—national, state, municipal, army and navy—have done excellent work and the practical achievements have been notable; but the work has been disjointed and sometimes conflicting. There has been a scramble for trained men. The army, because of its great need, has depleted many of the state and municipal health departments of their best officials; the U. S. Public Health Service, with new and arduous duties thrust upon it, has had the greatest difficulty in getting men to do the work; there have been conflicts of authority between various branches of government service, and between committees of public safety, and the regularly organized health authorities. Most of these differences have been occasioned through the zeal of the parties concerned to get things done, and these remarks are not made in any spirit of personal criticism, but merely to show the need of a more perfect organization of our public health activities.

For many years there have been those who have advocated the establishment of a national department of health, in order that the many bureaus which have to do with human health, now scattered through the several departments of the government, might be brought together under a single department head, and that there might be closer relations between the national and state health authorities. There have been forceful objections to the plan, some political, some legal, some administrative, and it has never found favor either in high medical circles or among the best known health officials. Without doubt, there are difficulties to be overcome; the police power, upon which many public health activities depend, is vested in the several states and not in the federal government; there are objections to an increase in the size of the Cabinet; there are personal and departmental prejudices to be met; yet, in spite of all this, it certainly seems as if the time had come for a thorough consideration of the whole matter on its merits, and for positive action. In my judgment, recent events have conclusively shown that the country needs a National Department of Health or a Department of Health and Education. Let us hope that the American spirit of achievement will not neglect this important foundation stone in building its future structure of national health.

Next we come to science—natural science, physiological science, physical and chemical science, engineering science, bacteriological science, statistical science—all working together along the four lines already mentioned. The boundaries between the pure sciences and the applied sciences have been obliterated, let us hope forever. No science has been found too abstruse to be of value in the Great War. Science is more and more becoming the basis of the four arts which sustain human

health. Those who know are sure to take the lead over those who do not know. Scientific education will receive, as it has always deserved, greater recognition and reward. Professor Ralph Adams Cram has written forcefully of what he calls the "*Nemesis of Mediocrity.*" It is an expression to be remembered. The world is not going to be satisfied with half knowledge, with half-way organizations, or with half-hearted attempts at education in hygiene and sanitation.

For a long time the engineering profession has been trying to frame a satisfactory definition of an engineer, but no one has ever yet succeeded. Neither has anyone ever satisfactorily defined a sanitary engineer. The best way to understand what is meant by the title is by the inductive process. The bacteriologist and the chemist learn that water can be purified by filtration; the sanitary engineer is he, who, knowing something about bacteriology and chemistry, can build the filter, operate it and test it. In order to do this, the sanitary engineer must know a good deal about chemistry and bacteriology as well as about the forces of nature, the characteristics of building materials, the possibilities of human labor, the use of tools, and the cost of work. The public health officer finds that the privies of a town are a public nuisance and a menace to health; the sanitary engineer is called upon, not only to build the sewer system, but to design, operate and test the sewage treatment works. The medical scientist learns that mosquitoes spread malaria and yellow fever; the sanitary engineer is called upon to drain swamps, oil standing water, and organize anti-mosquito work.

The sanitary engineer is called upon to ventilate buildings, install proper plumbing, provide for the removal of garbage, for cleaning the streets, for designing works to get rid of factory wastes. In short, a sanitary engineer is he, who, trained fundamentally in the science and art of engineering, has also been taught the principles of public health. Knowing the science of public health, he practices the art of the engineer.

In the same way it seems to me that the health officer of the future will be one who will know the various branches of public health science, but will practice the art of public health administration.

It seems to me that if we make this distinction between the art and the science, it will help us to untie some of the knots which, during recent years, have threatened to tangle up our educational systems.

There is gradually being developed a science of public health. It involves bacteriology, sections of biology, physiology, chemistry, physics, mathematics, engineering and statisics. It is broad and comprehensive.

These fundamental facts and laws which make up the science of public health should be taught alike to sanitary engineers, to health officers, and to physicians. Almost the first paper which I ever published was one read before the Society for the Promotion of Engineering Education in 1896. It was entitled *Biology for Civil Engineers.* In it I urged the study of biology in order that engineers might the better understand the changes which take place in organic materials, and the importance of the biological forces. I now find myself urging the study of engineering science—or certain parts of it—by health officers, and physicians.

Now let us view the subject in its centrifugal aspect.

There is one science of public health, but there are four arts to be practiced. While the science is something to be held in common, the arts of the engineer, the health officer, the doctor, the physicial director, and the preparer of vaccines and sera are obviously distinct. No one can successfully practice more than one of these arts, because the detailed knowledge required is too great. There is no need for the engineer to understand the arts of surgery, or for a doctor to know how to manufacture the vaccine he uses, or for the hygienist to know how to install the ventilating apparatus in the gymnasium in which he gives physical instruction. It is better that these arts should be kept separate. Specialized arts we must have in the interest of efficiency.

The lines of cleavage of the public health arts are already becoming distinct. Sanitary engineering has always been distinctly marked from the others, but it is only recently that the distinction between medical practice and public health administration has been recognized. The establishment of this new school at Johns

Hopkins, and the Schools of Public Health at Harvard University and the Massachusetts Institute of Technology, at Yale and elsewhere have given the movement for special instruction in public health a great push forward. The time is not far distant when no one can become a public health executive unless he holds a degree or a certificate in public health. In organizing a national department of health, this should be an important plank in the platform.

We are also seeing hygiene and physical education developing as a separate art for the maintenance of human health. The importance given to athletic and military drill, the multiplication of gymnasia and schools of physical education have been accelerating, and before long will become conspicuous in our educational system.

Even in the army we have seen a new line of cleavage develop during the present war. The Sanitary Corps, U. S. A., has developed as a new unit under the Surgeon General separate from the Medical Corps. It is organized to include most of what would naturally be regarded as public health agencies—matters relating to vital statistics, epidemiology, bacteriological laboratory work, sanitary inspections of all sorts—water supply, sewage and garbage disposal, mosquito control, etc. This is a decided step in advance, for the medical corps has all that it can attend to in caring for the sick and wounded, looking after stretcher service, ambulance service, hospital service, and convalescence and reconstruction work. This medical work is essentially personal service. The work of the sanitary corps is essentially communal service; it is public health practice applied to the army.

The U. S. Navy has not yet made this division between the medical service and the sanitary service, but probably it, too, would profit by the change.

Even more significant is the recent provision for a Reserve in the United States Public Health Service, in which sanitary engineers will have equal rating with the medical members.

It is not necessary for me to rehearse in detail the work of the sanitary engineer. Everyone to-day knows that sewage disposal, water purification, refuse disposal and street cleaning constitute his major operations, and everyone knows how the extension of these works during the last fifty years has given us cleaner streams, safer water supplies and, in general, a more wholesome environment—especially in cities—and how, in consequence, the death-rates have fallen in a most gratifying way. It is one of the satisfactions of my life to think that I have had a part in some of this work. But there are yet other things for the sanitary engineer to accomplish; there is new work for him to do as he follows on behind the sanitary and medical explorer, putting into practice on a large scale the things learned in the laboratory.

We cannot discuss such matters as I have been speaking of except in the light of what is going on in France to-day. As a result of our coming victory, there is going to be a social reconstruction of the world. Engineers and public health officials must therefore extend their thoughts beyond their usual bounds, for the new problems will be not only physical and physiological, but political and ethical. Engineers and health officers must join with the members of the other professions, and what is more important, perhaps, they must join with the workers themselves in laying plans for the new democracy, for the new social order that is to come. I would like to speak for a few minutes of the engineer's part in this great movement, because that is the profession to which I belong. In doing so I quote from an address which I recently gave before the Boston Society of Civil Engineers.

Engineers, as a class, are trained to look ahead, to draw plans, to anticipate the future. This is fundamental to the art. Because of his experience in looking ahead, because of his position as an intermediary between capital and labor, because of his habit of doing large things in large ways, the engineer seems destined to play an important part in this coming reconstruction.

We say there is going to be a new democracy and we welcome the thought—in fact, our sons are dying that the world may be free. The thought of democracy is in the air to-day. During the years before the war another word was on people's lips, *efficiency*. We prated of efficiency. We boasted of efficiency in this and that organization. Let us remember, however, that democracy and efficiency are in some respects antagonistic ideas. Democracies

considered as nations are inefficient. History tells us this fact, yet we need not go back of the present war to see it. An army is more efficient than a mob; an organized nation is more efficient than one not well organized; industry and transportation organized under the large corporation plan are more efficient than under the small unit plan. Organization and efficiency seem to be inseparable terms.

Where efficiency exists, the ruling power is almost invariably at the top and its branches extend downward, ever dividing as in the vagarious organization-charts which our bureaus of municipal research delight to draw. But what is meant by efficiency? Broadly speaking, it is doing much with little effort; it is getting out of a machine in one form the energy put into it in another form; it is making the most of the apparatus, the best use of time, accomplishing a result in the best way. In any measure of machine efficiency the thought is centered primarily on the result, secondarily on the power applied and the raw material consumed, lastly on the effect of the process on the machine itself. Under autocracy we see this idea illustrated in human society. The upper ruling power has a result in mind—it may be benevolent or selfish—the nation is organized to secure that result, all the units or the nation are required to work to that end, and the effect of the process on the constituent human units is regarded as a minor affair. The United States is temporarily and of necessity in this condition to-day. The object in view is to win the war; we are voluntarily organizing ourselves from the top down, to bring about this result; we are trying to make the most of our powers and resources; and we do not care what happens to any one of us.

But in times of peace conditions are different. Then the legitimate object of government is to provide conditions favorable for the life of each and every individual in the nation. The purpose of the nation is not ulterior, but interior. Efficiency takes on a new meaning. No longer is it a comparison between applied energy and material result, but a threefold comparison between process, machine and product, with the effect of the process on the machine as the controlling thought.

In mechanics we have no single word to express this idea, although we do speak of the "life of the plant," of "friction," of "depreciation."

In human society we have already some very old and very adequate words—health, comfort, happiness and contentment of the people—sometimes summed up in the word "welfare." In autocracy, efficiency means a comparison between work and result; in democracy, it should mean rather a comparison between work and welfare. Such relations might be called *beneficient*, to use an obsolete word with a somewhat new meaning—a word not to be confounded with *beneficent* or *benevolent*, both of which contain the element of charity. *Beneficiency* is not that; it is efficiency plus humanity. In this country, as in most civilized countries, we have striven for efficiency, and it is partly for this reason that the laboring people claim that we are an economic autocracy. It is well known that the movement for efficiency has not been received in a friendly spirit by the laboring people. Why? Because they believe just this—that efficiency considers the work and the product and leaves them out. Beneficiency would mean placing the product and the effect on the worker in equal regard. The world is demanding that this change be made.

The great contest will, as it always has, center around the problem of rewards. Few will deny that to-day rewards are disproportionate to service rendered the community in many of the walks of life. It has seemed to me that for many years the unskilled laborer, the common workman, has not received his fair share of the satisfactions of life. He has not been happy in his work, and if a man does not find happiness in his work he will not be contented, because a large part of every one's life is given up to work.

The change from the outdoor life of the farm to the indoor life of the factory, the extreme subdivision of labor by which a man or a woman does but one thing in a most monotonous way is largely responsible. The mind cannot get satisfaction out of quantitative work, out of so-called efficient labor, even though the money in the pay envelope increases. One great problem, therefore, is to find a way to make hard, routine work less monotonous, more enjoyable, more healthful. We cannot, of course, get away from work or from hard

work, if we try; there must also be self-sacrificing work. We can, however, improve working places with respect to hygienic and attractive conditions, and we can improve work with respect to hours and rest periods and to permanency of occupation. But we must also have efficient work and this means better planning of details.

To establish a uniform length of working day is wholly illogical. The human machine should be operated at its maximum beneficiency—at that rate at which it runs best for the machine and for the product, and for such intervals of time as are best for the product and for the machine. For hard, monotonous work there should be short days or days with broken periods just as an army is rested on the march; for varied work the days may well be longer. There is opportunity here for the physiologists of this new school to study and give advice. We can also hold the laborer in greater respect and provide rewards according to his ability, experience and faithfulness. The coal shortage and the food shortage have emphasized the dependence of human society upon common labor.

It has also seemed to me that the laborer of to-day does not get a fair opportunity to build a home, and next to work, perhaps even more than work, home life determines contentment. The first physical requisite of a home is shelter, family isolation, and a reasonable amount of individual privacy. Homes begin to vanish when cities become congested. Home life in an apartment, whether it be in aristocratic "chambers" or in a common flat tends to shrivel and disappear. A colossal blunder which civilization made in the nineteenth century was to allow cities to overgrow themselves, to allow urban life to develop disproportionately to rural life. Attracted by high wages, by prospects of easy living, by the pleasures which undoubtedly come from the foregathering of the people, the young men and women of the country flocked to the city, only to find in the end that the very elements of life—air, food, water, shelter, clothing—were being obtained with increased difficulty and cost, and that ephemeral pleasures and and easy conditions of living were being substituted for the solid satisfactions of home life. The decay of home life is reflected in the steadily decreasing birth-rate. We deplore all this, and wonder what we, as a nation, are coming to; but we fail to attack one of the most vital problems, namely, the decentralization of population. Congested city life may be efficient, but in the long run it is not beneficient to the mass of the people. Decentralization does not mean doing away with cities; it means substituting many cities of moderate size for a few cities of very large size. State planning is even more important than city planning.

Because the laborer has not received his fair share of the satisfactions of life he has endeavored to get them in the form of increased wages. It seems to me that in many cases this has gone too far. When a carpenter or a plumber or a bricklayer gets more money for his work than the engineer who directs the work—and this has happened repeatedly of late—when the laborer earns more than the small trader or the bank clerk or the school teacher or the clergyman, it shows that money rewards are not being given in accordance with what people are contributing to society. Granted that the big fortunes and the earnings of capital have in the past been excessive, it is probably true to-day that there is a strong tendency for the laborer to get too much money for the work he does. But when he gets it he still finds that he cannot procure with it the satisfactions of life; his extra leisure and his money are both spent unwisely. In other words, our money standard of rewards has failed. It has over-stimulated enterprise, it has brought about an unwarranted inequality in the distribution of wealth, and it has not brought contentment either to the laborer or to the capitalist.

The engineer has a unique opportunity to be a great social force in the new democracy, to bring about harmony between work and the worker, to make work beneficient. The engineer is the planner of cities, the designer of factories, the builder of roads and railways, the distributer of power, the digger of mines, the operator of all sorts of industries. What has he planned and built and operated for? Chiefly for product. He ought not to be criticized for that. It is a major element in the problem, and he has been content to consider that as his particular work. But the engineer has greater opportuni-

ties than almost anyone else to make working conditions and living conditions better for the worker. The engineer is often the inspector of the work done. Why should he not also be the inspector of the worker, and see that his yoke is made as easy and his burden as light as it can be reasonably made? Specifications are drawn for the product of work; why not better specifications for the worker?

It would not be just to say that these things have been altogether neglected. There has been a considerable improvement all along the line in recent years. Health protective measures are being put into specifications, provision is often made for the housing of workmen during construction; safety devices of all sorts are being rapidly put into factories; welfare work of many kinds is in progress; living conditions are improving; but these things have not been done as a matter of course, but rather by the compulsion of law or the benevolence or the patronage of the owner. The laboring people do not want these things in this way; they want them as a matter of custom and right. In fact, at the present moment the labor unions in America do not appreciate them as the great factor in their problem. They have two principal thoughts—more pay for less work and uniformity of pay regardless of ability. The labor unions of this country are far behind those of England in appreciating the importance of the conditions under which men and women work and in planning a constructive program to secure these and other benefits for all the people. The labor unions must have a change of heart if they expect to play the noble part in the beneficient democracy which they can play if they will. There are already signs of this change. The entrance of women into industry is bringing conditions under which people work into the limelight, for women are by nature more influenced by their surroundings than are men. If labor fails to take the fair attitude, is selfish, and overreaches as capital has overreached in the past, the new democracy will fail. Unless American skilled labor adopts a broad-minded, constructive policy, in which the rights and welfare of all are considered, the pendulum will swing far toward proletariat control and then swing back to autocratic conditions. There should be a serious effort on the part of the engineer to prevent it from swinging too far in either direction.

Engineers perform five principal functions—they advise, design, inspect, construct and operate. In these functions they come close to capital on one side and close to labor on the other. The advisory or consulting engineer and the designing engineer are almost invariably employed by capital. The constructing engineer, the contractor, and the operating engineer are close to labor and the laborer's pay often goes through their hands. As an inspector the engineer's attitude is judicial. Sometimes these functions are bound up in one individual, but more often designing, construction and operation are in different hands. In fact, the contractor and the operator may not be regarded as engineers at all. Labor, as such, is represented in the walking delegate, a sort of malign guardian angel, who knows nothing except the color of the sheep in his flock and who seldom, if ever, knows anything about the work which is going on. In my opinion, labor should be better represented, and I know of no one better fitted to protect labor than the engineer.

One of the great underlying causes of present-day labor troubles is that the laborer does not understand what capital really is, does not distinguish it from so-called special privileges, from the unjustified control of the resources of nature. To the laborer, capital is impersonal. The laborer does not know the people whose savings make his work possible, or even the person who handles these savings. Conversely, labor is likewise impersonal to the man of capital. In large establishments the employer does not individually know the people who work for him. This personal knowledge, each of the other, appears at first thought impossible of attainment in a complex civilization, with its enormous cities, its far-furrowed fields, its immense factories, its scattered mines. Individually it is impossible, but collectively it is not. The mine president cannot know all the laborers, but he can know some and through them the others. Not all of the laborers on a job can eat lunch with the big boss, but if a few of them did, once in a while, the acquaintance would be mutually beneficial. The greatest of all problems for the engineer is to help build a bridge between capital and labor. As a

rule, the laborers like the engineer; they see him on the job, working in old clothes, measuring, planning, directing; they see him eat and smoke, and they regard him as a human being like themselves. They know, too, that the engineer stands in with the man who is furnishing the money to pay for the job. But to properly fulfill this intermediary position the engineer must broaden his ideas of efficiency from that of the most work for the least cost so as to include benefit to the constructing laborer as he constructs, and benefit to the worker who is to use the constructed plant. And the hygienist must work with the engineer and show him what to do. So we come back again to our main theme, the need of co-operation between all who have to do with human health.

The war is getting the people of the world acquainted with each other. It is getting people to think about the resources of the globe in terms of world-wide necessities. It is elevating business, commerce and transportation to a higher plane than they have ever occupied before. It has emphasized the benefits of organization. The Christian missionaries were the first to take the world view. They were ahead of the business man in all of the far-distant and inaccessible places, and by their self-sacrificing labors they paved the way for a universal civilization. But the business man followed after the missionaries, and the threads of commerce are gradually binding the countries together. Hence the engineer is more and more to find a field for his service abroad.

When one considers Russia and Siberia —with their resources of field, forest and mine—China, Japan, the Philippines, and India, and when one considers also Africa, South America, Mexico, Cuba, and the many tropical islands, it is evident that the resources of the world are very far from being exhausted. More and more must the engineer think in terms of the world.

But in doing so the idea of exploitation must forever be renounced. Of course there must be profits commensurate with the effort; there must be business stimulus; but in the new democracy these rewards must be widely distributed, and the conservation of resources of other countries must be practised as well as the conservation of our own. To over-develop foreign commerce in natural productions would inevitably lead to further wars. Beneficiency must be practised abroad as well as at home. The work of engineers in foreign lands will greatly help solve our own problems. Let us take, for example, the control of Chinese floods, the greatest hydraulic problem in the world. If American engineers can help China solve this problem, the problem of the Mississippi will afterward be as child's play. If American sanitary engineers can teach China how to solve her sewage disposal problem and to utilize the fertilizing elements of human beings in a decent manner it may revolutionize sewage disposal in America.

Foreign service is especially attractive to young men. The scattering of young men through the English colonies has been of great benefit to Great Britain. It would be well for us to encourage such service in order to interest our educated and influential young men in governmental work and thus raise the standard of the personnel engaged in such work.

The International Health Board of the Rockefeller Foundation is doing pioneer work in this direction which cannot be too highly praised. Few realize what America is already doing for the health of the world. Even within the short space of five years students have left our School of Public Health of Harvard University and the Massachusetts Institute of Technology for work in China, in Central America, in South America, in Siam, in Italy, in Russia, in Servia, in Greece, in Palestine, and in the Fiji Islands. Last year in Peking I had the pleasure of attending the ceremony of the laying of the corner stone of the new Union Hospital of the China Medical Board. This was a notable event. China needs medical help and nobly has the Rockefeller Foundation gone out to give this help. But China needs sanitation. No traveler in that most interesting country fails to record that fact. Seldom, however, does one have the vision to see and the faith to believe that sanitation in China is an attainable possibility, but students and instructors alike in our School of Public Health have been inspired by the presence during the past year of Dr. W. W. Peter of the Joint Council on Public Health Education, who is making

this problem his life work. A physician by education, a missionary by profession, he sized up the problem during several years of residence and travel in China, then came back to America to study public health measures. He studied preventive medicine, hygiene, vital statistics and engineering, he learned how to make sanitary surveys, and now he is going back to teach and organize—to tell the Chinese that they need not only hospitals but clean and wholesome surroundings; that China can never become a great and strong power until her citizens are clean and healthy. He told us that the Chinese complimented him by saying he was "an American with a Chinese heart." I wish to say that he is a missionary physician with an engineering mind and the American spirit.

What Dr. Peter is undertaking in China must be done in many parts of the world. It is notable that the American Red Cross in sending its missions to Servia, Russia, Greece, Palestine, and to the Balkans has included sanitary engineers as well as physicians. Nobly have they worked side by side. Each has seen the qualities of the other stand out as essential in undertaking the great problems of relief and reconstruction; each has come to feel that while different they are mutually dependent. It would pay the American Red Cross to strengthen still further its connections among engineers.

The American Red Cross Mission which was sent to Russia in 1917 was typical of the union of forces necessary to keep the world in physical health. There were the physicians, notably Dr. Frank Billings of Chicago University, and Dr. William S. Thayer, claimed by both Johns Hopkins and Harvard; there were the bacteriologist and chemist, Professor Winslow of Yale and Professor Sherman of Columbia; there was Raymond Robbins, the sociologist; there was the man of business, Harold Swift; and there was the great-hearted banker and capitalist, William B. Thompson; the speaker had the honor of representing sanitary engineering. There were others—lawyers, business men and a transportation expert—but these I mention especially because they illustrate the *e pluribus unum* of public health. And these men, moreover, were imbued with that American spirit which I believe is going to lead to great and speedy achievements in public health, a spirit of courage and visualized success.

I began by referring to a conversation on the Pacific. I end by recalling a moonlight night on the Japanese sea, the night before we reached Siberia, when our beloved Dr. Thayer, a splendid example of the American spirit, with his thoughts going forward to Russia and going back to her whom he left behind in Baltimore, also a noble example of the American spirit, recited to us Lowell's Commemoration Ode:

"O Beautiful! My country!

. . . .

What words divine of lover or of poet
Could tell our love and make thee know it
Among the Nations bright beyond compare?
What were our lives without thee?
What all our lives to save thee.
We reck not what we gave thee
We will not dare to doubt thee.
But ask whatever else, and we will dare!"

CHIP FRACTURES OF TERMINAL PHALANGES*

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My excuse for submitting this preliminary report on chip fractures of the terminal phalanges is that it is a condition frequently overlooked not only by the civil practitioner but also—and more important from the workingman's standpoint—by the industrial surgeon as well.

The fact that the condition is so frequently overlooked is undoubtedly due to the absence of objective signs of fracture. As a rule, the history is usually one of very slight trauma and the injury is therefore looked upon as a simple contusion. Thus, in a series of twenty-seven cases of chip fractures, I find that ten of these were due to getting a finger caught between two small pieces of steel and three were the result of a finger being jammed in the door of an elevator. In practically all of these cases the objective signs were very slight, consisting in most cases of slight hemorrhage under the finger nail, some tenderness and more or less swelling.

The importance of this injury is due to the lost time which results from it, a matter of prime importance to the workingman. One of my patients lost 196 days; seventeen lost an average of aproximately sixty days each; nine men did not stay out from work more than three days, even though suffering from this injury, and from an insurance standpoint were considered "no lost time" cases.

The amount of lost time in the great majority of these cases is the more impressive when it is noted that very rarely does transverse fracture of a phalanx compel a man to remain out of work for more than five weeks, and where apposition is good, the patient may be able to go back to work in much less time.

What are the reasons for the long disability periods following chip fractures of the phalanges? This question may be answered in three words, namely, persistent tenderness and infection, the latter being by far the more important cause. The infection in these cases has no connection with a wound which may have been present at the time of injury. As a matter of fact, infection occurs just as frequently in cases where there is no wound, and, when it does appear, it occurs in all cases after a lapse of time inconsistent with the entrance of infection at the time of injury.

If not due to the entrance of infection from without, what then is the cause of this infection? Kanavel has shown that the diaphysis of the distal phalanx receives its blood supply after the artery enters the connective tissue which forms the pad on the palmar aspect of the finger tips. Following this idea, Moorhead believes that this arrangement accounts for frequent involvement of bone in neglected or improperly treated cases of inflammatory conditions of the tip of the finger, the so-called "bone felon"; for, as he explains it, the swelling within the space "shuts off the blood supply of the diaphysis, because the artery only functionates after it enters this crowded space—hence necrosis and osteomyelitis frequently occur."

It seems to me, then, that we have a similar condition in a chip fracture of a terminal phalanx. The injury causes swelling, the blood supply is partially cut off and the chip, which is often well separated from the main portion of bone, not obtaining nourishment, acts as a foreign body. The surrounding tissue breaks down and we soon have a low grade infection. This explanation is borne out by the fact that in nearly every case of infected finger following a chip fracture, the swelling was more intense at the time of accident than in those cases whose recovery was unaccompanied by any such condition.

The second important cause of lost time following chip fracture of a phalanx, namely, persistent tenderness at the tip of the phalanx, is probably due to nonunion of fragments, the motion of the fragments causing the pain.

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The following two cases illustrate sepsis following this type of injury:

Case 1.—E. K. (S. A. 5781), aged 21, single, was injured June 28, 1918, by a swinging chain striking his middle finger. Examination showed a very slight abrasion. The tip of the finger was rather badly swollen. There was no crepitus or deformity but some limitation of motion was noticeable in the distal joint, due to the swelling. X-ray showed a chip fracture of the terminal phalanx (Fig. 1). The injury was treated with a hot soak, an alcohol dressing, and a throat stick splint. With the exception of persistent tenderness there was nothing worthy of note in the record of this case until about July 17, when the tenderness became more severe and the patient complained of throbbing pain. Meanwhile, the abrasion had healed. July 19, there was a slight sero-purulent discharge from under the distal portion of the nail; July 21, there was a frank pus discharge and the nail was removed; July 23, there was considerable discharge from the sinus, which was enlarged and drainage instituted. On July 26, X-ray showed thinning of the bone in the distal phalanx, and on this day the patient was etherized and the distal phalanx amputated. From this time on convalescence was slow, due to a slight ascending infection. The patient did not return to work until January 10, 1919.

Fig. 1.—Case 1.

Case 2.—J. L. (D. 492), a married man, aged 36, with six children, was injured on March 18, 1918, by a small piece of piping which fell on his right index finger. The injury was diagnosed as a small contused wound of the tip of the right index finger. X-ray showed a chip fracture of the terminal phalanx. The plate is not available, but the fracture was similar to that seen in Case 3.

Fig. 2 (Case 3).—X-ray showing wide separation of fragments.

The history of this case was uneventful until April 5. At this time infection developed, and a few days later X-ray showed necrosis in the distal part of the phalanx. Amputation was performed, as in the preceding case. A long convalescence ensued. The patient returned to work July 15, 1918, but required dressing for some time after.

With Case 2 in mind, the following case is instructive:

Case 3.—T. C. (S. A. 5402), a married man, aged 29, was injured on April 17, 1918, by having his finger slightly jammed in a port hole cover. The diagnosis was made of a small contused wound, on the lateral aspect of the left middle finger, over the terminal phalanx. X-ray showed a chip fracture of the terminal phalanx with wide separation of the fragments (Fig. 2). The wound was cleaned and tincture of iodine, an alcohol dressing and a splint applied. On April 20 the wound was clean, but the nail was somewhat raised by collection of blood underneath. On April 23 the nail removed under aseptic conditions. The wound healed and on April 29 was entirely clean. There was, however, tenderness on pressure over the chip and the patient was unable to pick up a small object with this finger and thumb because of the tenderness. May 3, there were no objective signs, but the patient still complained of some tenderness at the tip of finger; May 18, the tip of the finger was slightly swollen and painful with tenderness more marked. The question of the advisability of removing the chip was considered and on May 22, under gas anesthesia, an incision was made over the tip of the finger and the chip removed. X-ray showed the chip gone (Fig. 3). Convalescence was practically uneventful and the patient returned to work in about three weeks. On March 15, 1919, this patient reported that he had had no further trouble with the finger.

FIG. 3 (Case 3).—X-ray after removal of chip.

It is well to note that the patient above, with an injury identical with that of Case 2, lost sixty-eight days, whereas Patient 2 lost one hundred days. The disability period in the third case would have been made shorter had the chip been removed earlier.

The following case was one of the first cases that attracted my attention to the seriousness of this injury, and, though it did not result in sepsis, yet the finger remained so tender and useless that the terminal phalanx was eventually amputated.

CASE 4.—S. J. (S. A. 3111), a married man, aged 39, was struck on the finger on Feb. 13, 1918, by a plank. There was no wound. The patient reported to the hospital and received treatment for contusion of the finger tips. He did not report again to the Yard Hospital until February 28, having in the meantime gone to a Boston hospital, where he was told that amputation was the best way of treating his condition. On this date an X-ray taken at the Fore River Hospital showed the condition seen in Figure 4. It is interesting to note that only the middle finger was causing any trouble, the point of greatest tenderness being directly over the smaller chip. February 26, there was marked tenderness on pressure and the patient had a typical club finger, as is well brought out in the X-ray. By April 1 the tip of finger became more swollen and tender and contact with cold caused extreme pain. The patient begged to have the middle finger amputated. On May 13, as the condition was growing worse and the patient insisted on something being done, consultation was held and amputation of the distal phalanx agreed upon as the proper method of treatment. This was done under local anesthesia. Examination and dissection of the portion amputated showed the tissue to be edematous and of a firmer consistency than the normal finger tip. The fragment (X) was necrotic, freely movable and connected to the main portion of bone by fibrous tissue. The other fragment showed some slight bony union. The patient was discharged cured on May 25, 1918. He lost in all about ninety days.

It may seem that unduly radical treatment was used in this case, but I feel it to have been justifiable when we consider that the finger was useless to the man in its condition at the time of amputation and that the removal of the phalanx relieved him of considerable pain. Moreover, removal of the chips in this case would not, I believe, have solved the difficulty because of the lack of motion in the distal joint. Furthermore, the patient's chances of obtaining a first intention healing would have been lessened, as the tissue at the tip of the finger, under these conditions, does not seem to have the resistance of a normal finger. This is shown by the fact that where chips have been removed under strictly aseptic conditions, there tends to be a breaking down of the wound.

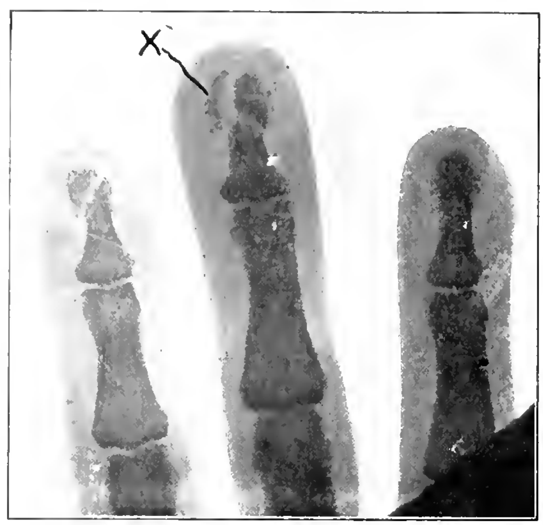

FIG. 4 (Case 4).—Fragment *X* necrotic.

The following is an example of this condition:

CASE 5.—Mrs. J. B. (A. B. 47), a married woman with two children, was injured on Sept. 24, 1918, while opening a door in an elevator, by jamming her finger between the door and the frame. The injury was diagnosed as a small contused wound

of the right middle finger. There was very little swelling. The wound was cleaned, swabbed with

Fig 5—Case 5.

iodine and an alcohol dressing and splint applied. X-ray showed a chip fracture of the terminal phalanx of the right middle finger (Fig. 5). It will be noted here that the fracture was very similar to that of Case 3, except that in the latter the chip was smaller and more widely separated from the main portion of the bone. As this patient lived a considerable distance from the plant, she reported for further treatment to a doctor in her own city, and apparently convalescence was uneventful. She reported to me on Nov. 30, 1918, complaining of extreme tenderness on trying to use the finger and asked that something be done. Examination showed marked tenderness on slight pressure over the tip of the finger and some swelling. The patient was advised to use hot soaks and to give the finger absolute rest. December 8, there was increased swelling and the patient stated that there was no improvement; December 10, the chip was removed under apothesine anesthesia. December 14, the wound was clean. A dry sterile dressing was applied. December 16, the stitches were removed. From the time of operation the wound appeared clean until December 24, when moisture, with slight discoloration, was observed about the edge of the wound. By December 27 the skin had broken down and become blackened and there was a slight discharge of sero-purulent material. On January 3, 1919, the dead skin was removed and an alcohol dressing applied, and by January 17 the wound had healed satisfactorily.

It would not be fair to leave this subject without reporting the following case in which the X-ray showed a type of chip fracture that would be expected to cause at least as much trouble as any one of the preceding cases, the chip being small and well-separated from the main portion of bone. Though the patient in this case lost twenty-seven days, chiefly due to the tenderness, sepsis did not develop and the finger now causes the man no particular trouble and he is satisfied to leave it in its present condition. It is rather important to note, in this particular case, that there was no swelling at the time of injury.

Case 6.—T. T. (T. A. 59), a single man, aged 40, was injured on May 21, 1918, by getting his finger caught between two plates. The diagnosis was made of lacerated tip of the index finger with evulsion of the nail. The wound was cleaned and a dry sterile dressing applied. X-ray showed a chip fracture of the terminal phalanx of the left middle finger (Fig. 6). An attempt was made to mould the fragments into better position. X-ray, however, showed no change in position. On May 28, there was some localized tenderness, but the wound had healed and there was practically no swelling. On May 31, 1918, there was still some tenderness, but no swelling. Unfortunately, this patient did not report to the hospital again after this date, but he is reported to be working and apparently has had no trouble since.

Fig 6.—Case 6.

I will give one more case to show the length of time a man may be incapacitated for work, where persistent tenderness is the only symptom. This is an old case and came to my attention quite accidentally.

Case 7.—N. S. (W. 502), a married man, aged 40, had his ring finger jammed between two pieces of steel on July 23, 1917. He was treated at that time for laceration of the finger. By August 24 the wound had healed and the patient was discharged. This man left the employ of the company soon after and went to work for a time at some other place. He was not heard from until September 4, 1918, when at a court

hearing he claimed to have been unable to work regularly since the accident, on account of tenderness at the tip of his finger. I examined him and found a slightly swollen finger tip with marked localized tenderness over the tip. X-ray, on September 5, showed a chip fracture of the terminal phalanx. Operation was advised and accepted. The chip was removed and after a week or two the man went to work and has had no trouble since.

CONCLUSIONS

1. Chip fractures of the terminal phalanges are a comparatively serious injury from the working-man's standpoint.

2. In a plant hospital, all contusions of fingers and toes, especially those accompanied by any degree of swelling, should have an X-ray.

3. The general plan of treatment should be expectant at first. In the face of increasing swelling or tenderness after the first few days, or persistent tenderness after the fourth week, the removal of the chip should be accomplished. The sooner the chip is removed after the fourth week, the better the chance of having the wound heal by first intention.

INORGANIC POISONS, OTHER THAN LEAD, IN AMERICAN INDUSTRIES *

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ZINC, COPPER AND BRASS

The earliest case of brass poisoning that I have been able to find in our literature is that reported from Dr. Osler's clinic at the Hopkins by Oppenheimer (1) in 1895. This rather obscure case was very thoroughly worked out and clearly presented. The man, who worked in a bell foundry, had already been under treatment at the Hopkins for lead poisoning contracted in the course of his work, and came back three months later complaining of breathlessness and other symptoms of uncompensated heart lesion. Careful questioning brought out a history of chills, perfectly typical in character, but when one thinks of the frequency of malaria in Baltimore and the total lack of anything on brass chills in American literature at that time, one cannot help congratulating Dr. Osler or his assistant on this case. Oppenheimer even collected the powder deposit from the fumes of the bell metal and had it analyzed.

The first thorough piece of work on poisoning from brass in the United States was written by M. H. Sicard (2) in 1905. Up to that time some confusion had evidently existed in this country as to the real cause of brass founders', braziers' and brass polishers' poisoning, a curious fact, because as long ago as the first quarter of the nineteenth century Thackrah of England had shown very clearly and conclusively that zinc was the poison in these occupations which gave rise to the so-called ague, chills or "shakes." Sicard gives a review of the English literature and adds to it observations of his own. He points out the importance of lead and also of arsenic in industrial poisoning among brass workers and believes that the multiple neuritis described by one of the British writers, Suckling, as caused by zinc, is really lead poisoning, as is probably also the gastric pain, vomiting and constipation from which such men often suffer. He made blood counts on men selected at random in a brass foundry and obtained very interesting results. In every instance there was an increase of large monuclears, sometimes as high as 30 per cent., always up to 17 per cent. I do not know whether these blood findings have ever been confirmed. If not, it would seem worth trying. The condition could hardly, however, be attributed to the action of zinc, since these men were

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working either in pure copper or in high-grade brass with a low zinc content.

In 1904 two articles on poisoning in brass polishers were written, in one of which the copper was held responsible, in the other no theory was advanced. Moyer and Lavin (3) reported a case of fairly severe chills coming on about once a month, in a brass polisher, who had been only three years in the trade. The patient had also chronic constipation, alternating with diarrhea. The occupational factor seemed to be beyond question for he promptly relapsed a few days after returning to work. Pietrowicz's (4) case was so severe that one hesitates to attribute it to brass poisoning alone. The patient was a polisher, not a founder, who had been at the work for fourteen years. He had, in addition to the chills and muscular cramps characteristic of brass poisoning, an advanced degree of arteriosclerosis, with failing memory, constant headache, vertigo, obstinate constipation and anorexia, emaciation and tremors, and atrophy of the muscles of the hands. Certainly one would think of lead in this case, if not in the case of Moyer and Lavin.

Moyer and Lavin consider their case to be one of copper poisoning, partly because the man was not exposed to zinc fumes, but chiefly because of the greenish line on his teeth midway between crown and gums.

Pfender (5) reported in 1914, brass chills in a brazier in whom very severe attacks would come on suddenly when he reached the outer air. This patient would be seized with a shaking chill, headache, then fever, severe pains in joints and muscles and sometimes vomiting. Profuse sweating and prostration would follow.

Hayhurst (6) of Ohio has made a complete study of brass poisoning in this country, his observations having been made in connection with a survey of the state of Illinois in 1909, and of Ohio in 1913 and 1914. Hayhurst defines brass founders' ague as follows: "It may be defined as an acute malaria-like syndrome of chill, fever—sometimes—and sweating, appearing a few hours after inhaling for a few minutes or longer, vapors or fumes arising from molten brass or from fumes of pure zinc alone, affecting mostly those unaccustomed to such exposure; further characterized by the development of a form of temporary immunity and absence of immediate serious or fatal consequences, a lack of definite pathology and the probable development of a non-resistance to infection which accounts for the increase in morbidity and mortality of persons exposed." New men or those just back from a vacation are most likely to suffer. The attacks rarely if ever come on in the plant, but after the man has gone out into the air, or after he has reached home. Winter sees a decided increase in the number of men affected, perhaps because windows are closed and the fumes worse, perhaps because of the cold which precipitates the chill.

Brass founders' ague is found most frequently in founders who are exposed to the dense whitish-green fumes rising from the molten brass as it is poured into molds. This pouring may take place four or even six times a day and as in most foundries it takes at least ten minutes and in some half an hour to clear the air of fumes after each pouring, the amount breathed in during a day's work may be very great. Furnace men have the worst of it.

Brazing consists in heating the edges of two metallic surfaces till they fuse, usually with the aid of a solder which contains brass. It is done sometimes at forges, sometimes at benches with blowpipes, and the fumes are largely zinc. Brass founders' ague occurs among braziers, but not to the extent that it does among founders.

Galvanizing consists in dipping metal which has been pickled with acid into a bath of hot zinc. If this bath had been allowed to get hotter than is usual or necessary, the galvanizers may get brass chills.

Finally, it is apparently possible for brass polishers to have chills, though it is harder to accept these cases and one is always inclined to suspect lead poisoning.

Hayhurst discusses the different constituents of brass and dismisses copper as a possible cause of the sickness of founders and braziers. Seventy-five coppersmiths in Chicago had no occupational disease. The boiling point of copper is high, while that of zinc is low, lower even than lead. In rare instances when copper has been raised to a great heat, as in an electric furnace, Hayhurst believes poisoning

may occur and quotes an instance related by an engineer, Hanson (7). The men suffered severe influenza-like symptoms, quite similar to those caused by zinc fumes. It is possible also that in the case of men working with German silver—an alloy of copper, zinc and nickel—the fumes from the copper may cause trouble, for here the heat must be high to melt the nickel.

Hayhurst found typical brass chills among the men smelting zinc in La Salle County, Illinois. These men are not nearly so much exposed to fumes as are brass founders, and consequently do not suffer so much from chills. It is also possible for a man to breathe enough fumes from the process of autogenous welding of two zinc surfaces with an acetylene flame, to get brass chills, as has been reported recently by the Illinois State Factory Inspection Department.

The poisonous agent is a flaky oxide of zinc which forms in the air and falls on all surfaces when the greenish fumes from molten brass cool. Yet zinc oxide is itself harmless. Moreover, brass chills are followed by a rise of temperature, a symptom not caused by metallic poisons, and instead of being a cumulative poison, there is a rapidly developing immunity. On these grounds Hayhurst is inclined to believe that the action of the zinc fumes is the following: Zinc carbonyl, $ZnCO_2$, is formed as the fumes cool and this, spreading over the great extent of surface of the lungs, sears the surface cells by virtue of its hygroscopic property, and there is, in consequence, a resorption of toxalbumins from the destruction of cells, the symptoms being well accounted for by such a poison.

Hayhurst examined in his Illinois survey 187 brass workers, 146 of whom had had brass chills. He found an unusually large proportion of young men for a skilled and well paid trade. Out of 1761 men, 1500, or 85 per cent., were under 40 years of age and only seventeen, 1 per cent., were over 50 years. The figures are worse than those of Tatham upon Birmingham brass workers. Tatham found 10 per cent. of these workers over 60 years of age, and thought this a shockingly low figure. Hayhurst's Ohio report gives 124 cases of brass poisoning, one in galvanizing, eight in brazing, and 115 in foundries.

There is an interesting early observation published in 1892 by Walton and Carter (8). These authors describe two cases of multiple neuritis in metal turners, patients with practically the same symptoms. Both had paralysis and complete atrophy of the muscles supplied by the ulnar nerve, while the muscles supplied by the median nerve escaped. There were only slight sensory disturbances. The left hand of each of these men was in a position with the little finger, the ring finger and the thumb flexed, while extension of the wrist was unaffected. Both men had used the left hand to hold the lathe, cramping the fingers to grasp it. The authors doubt if the metal, brass or copper, had anything to do with the condition. Probably they are right, but one cannot help thinking of the paralysis described by foreign writers as occurring in file cutters, affecting also the ulnar nerve, and resulting from exhaustion and lead together.

The presence of lead in brass is an important feature which must never be forgotten. Lead is present not only as an impurity in the zinc, but is added in varying proportions to the different alloys. Arsenic also may form an impurity and phosphorus may be added, as in the making of phosphorus bronzes, but Hayhurst has not found, as yet, any evidence of phosphorus poisoning in the brass industry.

ARSENIC

I know of but one extensive article in American medical literature on industrial arsenical poisoning—a paper by Noble W. Jones (1) of Portland, Oregon, on industrial poisoning in the MacArthur-Forrest cyanide process for recovering gold and silver. Jones describes the various industrial processes which may give rise to fumes of arseniurretted hydrogen by bringing about the conditions of Marsh's test for arsenic, namely, producing nascent hydrogen to act on a soluble salt of arsenic. Such conditions are found when hydrochloric acid or sulphuric acid comes in contact with an arsenide of tin or zinc; or when water comes in contact with an arsenide of the alkali metals; or when a hot solution of potassium cyanide and powdered zinc acts on a reducible compound of arsenic. This last takes place in the so-called MacArthur-Forrest

cyanide process for working up low grade gold and silver ores. The cases described by Jones occurred in the Utah mining country. There were five patients, all severely poisoned, two dying. In this process dilute potassium cyanide is used to dissolve gold, and is then filtered through a bed of zinc dust, precipitating the gold partly in a fine metallic form and partly as the double cyanide of gold and zinc. Arsenic is commonly present in the ores and in the zinc. The men who were poisoned suffered from jaundice, hemoglobinuria and nephritis. In the most serious cases the skin was deeply bronzed, the urine very dark, there were sharp paroxysmal pains in the loins and radiating down to the thighs, and there was nausea and vomiting. In spite of great destruction of red cells as shown by hemoglobin in the urine, there was no sign of air hunger. The two men who died had complete suppression of urine before death, and autopsy showed hemorrhagic inflammation of liver and kidneys. Jones says that cases of arsenical poisoning were frequent during the first years after the cyanide process was introduced, but are much rarer now.

A case somewhat similar was reported to me by Dr. James Arneill of Denver. The patient was employed in a cyanide process plant and suffered from profound anemia and nephritis.

Other observations of industrial arsenical poisoning in the United States are scattered and are not very detailed. Our most important arsenic industry is the manufacture of insecticides, Paris green (the acetoarsenite of copper) and lead arsenate. The two centers for this manufacture are Brooklyn and Chicago. While working for the New York State Division of Industrial Hygiene, Lester Roos examined fourteen men in two Paris green factories and found three with inflamed eyes, two with ulcers, and four more with scars of old ulcers and furuncles, and two with marked anemia. The Paris green plants in Illinois employ a very fluctuating force of workmen, varying from about twelve in October to 561 in March. Few men remain in the work for long. It is one of the many industries in which a rapid labor turnover makes for the protection of the men against poisoning.

The reports of the Illinois Factory Inspection Department for the years 1912 to 1916 have several items on arsenical poisoning. These reports note that scrotal ulcers are pretty common among the men working in Paris green. Six cases of poisoning from Paris green and two from lead arsenate are noted one year; twenty cases another year from a force that varied between sixteen and 178. Two of these patients had ulceration; two, conjunctivitis and inflammation of throat and nose; the others, colic and constipation. I do not believe cases of poisoning from lead arsenate have ever been thoroughly enough worked up for one to say which element is the more important. In 1913 Dr. George Apfelbach made an autopsy on a very rapidly fatal case of arsenical poisoning in this same industry, the man dying after less than two weeks' exposure.

It is excessively hard to protect workers in Paris green. Two cases are on record of arsenical poisoning from the use of Paris green or arsenate of lead as a spray for fruit trees. The powder is very light and fluffy and it has, so far, been impossible to carry out mechanical packing. No protection can be worn which makes the skin perspire, for perspiration only increases the danger of ulceration. Respirators do this by pressing on the skin and making it soft and thin. The best procedure seems to be to plug the nostrils lightly with cotton, to plug the ears in the same way, and to smear the face over with some bland ointment. A full shower bath ought to be taken at the end of work and the work-clothes should be clean each day. Even with all these precautions, the largest factory in Illinois has cases of arsenical ulcerations of the nostrils, perforations of the septum, ulcers at the corners of the mouth, around the genitals and even on the feet from wearing leaky rubber boots.

In smelting the western lead ores, large quantities of arsenic are volatilized and carried over with the lead into the fume lines and bag house. The flue and bag-house men are specially protected by providing them with clean overalls and pads to tie over their noses and mouths and by making them take a shower at the end of work. Only one serious case of arsenical poisoning was reported to me in the Utah smelters, a Montenegrin, who had

an arsenical multiple neuritis and nearly died. However, several physicians told me that they had seen mixed cases of arsenical and lead poisoning and that, except for the ulcers, it was not possible to say which symptoms were attributable to which substance.

Arsenical poisoning is not at all uncommon in Perth Amboy, N. J., where the great lead refinery works up western and Mexican lead and copper bullion, both containing arsenic. There are also cases from the copper works, which apparently use arsenical copper. I have, however, never been in this plant. I think the most conspicuous instance of that deplorable lack of curiosity which one sees in physicians now and then, was furnished me in Perth Amboy by a doctor who told me that he had witnessed an autopsy on a case of industrial poisoning. The body, he said, was a deep mahogany color all over, the deepest discoloration of skin he had ever seen, and the organs were much congested. He did not know to what the man had been exposed, had not even asked, though he had a vague idea it might have been arsenic.

Wholesale poisoning by the fumes of arsenieurretted hydrogen has been reported several times, the victims being always persons confined in ill-ventilated parts of a ship, carrying in the hold a cargo of an alloy of iron and silicon, ferrosilicon. This is a very important compound used in the manufacture of electrodes and in the production of steel. It is made by fusing together silicon (sand and quartz), coke, and iron in an electric furnace. Arsenic may be present in the quartz or in the iron, and in the presence of the coke it is converted into calcium arsenide which in moist air is partly changed to arseniurretted hydrogen. If the silicon is present in the alloy in the proportion of less than 30 per cent. or more than 70 per cent., this does not occur; the dangerous points are between 40 per cent. and 60 per cent. silicon. Formerly we imported our ferrosilicon from Germany, but of late years we have made it at Niagara Falls. The only instance of poisoning of this kind, which can by any stretch be called American, is that recounted by Kober (2) as occurring on the *Vaderland* bound from Antwerp to New York with a cargo of ferrosilicon. Fifty steerage passengers came down with a mysterious sickness from which eleven died. The vessel was detained at quarantine under the suspicion of plague, but the discovery of the nature of the cargo explained the real cause of the sickness.

W. Gilman Thompson (3) speaks of still other sources of arsenical poisoning, the use of Paris green in paints and dyes and of white arsenic in the curing of furs and feathers. According to him, an American chemist found arsenic in eleven out of forty-two samples of furs, sometimes as much as 170 grains to the square yard. Thompson himself saw a case of arsenical peripheral neuritis in a tannery worker. Two of Thompson's patients, a dyer and a paint mixer, had marked general bronzing of the skin.

Hayhurst (4) found that in an Ohio glass works the following toxic ingredients were used in compounding; litharge and red lead, soda ash and arsenic, occasionally antimony. All these are in powder form and one plant was using as much as two tons of arsenic trioxide a month.

ANTIMONY

Antimony is an important metal in two industries only. The first, the making of printers' metal, includes making metal for stereotype plates, electrotype plates, monotype, linotype, and ordinary letter type. According to Dr. Earle B. Phelps (1) of the Public Health Service, the proportion of antimony used in type in the Government Printing Office runs from 16 per cent. for monotype casting to 3 per cent. for electrotype. In Germany, Sommerfeld (2) and Lewin (3), and in England Legge and Goadby (4) believe that the addition of antimony to lead decidedly increases the danger of lead poisoning, for while antimony volatilizes at a higher temperature than lead, the addition of antimony to lead, up to a certain proportion, results in a mixture which has a lower melting and volatizing point than pure lead itself.

Of course the fact that the symptoms of antimonial poisoning are so like those of lead poisoning, makes it very hard to discover how great a part antimony plays in any case of occupational disease which occurs in a man exposed to both metals, as printers are. I could not find any evi-

dence of antimonial poisoning in an examination of printers in 150 different shops, unless it was responsible for two bad cases of eczema of the hands and forearms of men working at the stereotype kettles.

The same difficulty is encountered in the second industry in which large quantities of antimony are used, the manufacture of rubber. Golden and crimson sulphides of antimony (really mixtures of the pentasulphide, the trisulphide, and the oxysulphide in different proportions), are used in great quantities and so carelessly that one often sees men covered from head to foot with the reddish-brown powder. But these men, the compounders and those on the mixing mills, are also handling litharge and lead sulphate, and whatever symptoms they suffer from are much more likely to be caused by lead. In fact, toxicologists in general seem to think the sulphides of antimony quite harmless, only Kobert believing that large quantities of the dust might cause poisoning in a workman. In order to throw some light on this question, the Bureau of Labor Statistics asked Professor A. J. Carlson of the Physiological Department of the University of Chicago to test the solubility of golden and crimson sulphides of antimony in human gastric juice. Dr. Carlson used commercial mixtures obtained from the B. F. Goodrich Co., of Akron. He found that about 8 per cent. of the antimony in the crimson and about 3 per cent. of the antimony in the golden sulphide, was soluble in gastric juice, making it clear that these compounds are soluble in the human stomach. Dr. Carlson (5) believes it to be probable that this solubility is sufficient to be a source of danger to men who are obliged to use these compounds in such a way as to expose them to a great deal of dust, or who handle food or tobacco when their hands are smeared with these sulphides of antimony.

Finally, antimony trisulphide is used in making fulminate caps, and according to an expert of the Ordnance Department, some cases of possible antimonial poisoning were reported from that industry during the war, though it is impossible here also to separate the effects of the antimony from those of the fulminate. The symptoms enumerated by the ordnance expert, i. e., a local irritation of the skin and of the respiratory mucosa, might certainly be due to fulminate.

MERCURY

About one-fifth of the world's supply of mercury is mined in the United States, in Texas and California, mostly as the sulphide, cinnabar. Kober (1) quotes the *Eleventh Census Report* as saying that 10.44 per cent. of the mercury miners of New Almaden, Cal., suffer from mercurialism. That is the only statement I know of concerning mercurialism in miners and it seems rather insufficient.

The industries that use mercury in the United States are many, but not so numerous as in European countries. Apparently Europeans still silver mirrors with mercury; we use a silver nitrate-potassium tartrate process. They use so-called water-gilding with mercury amalgam; we use electroplating, though fire gilding is still somewhat in use in this country. I suppose our most important mercury-using trade is the making of hatters' fur and of felt hats. Then would follow—though this order is not given with any surety—making thermometers and barometers, making incandescent lamps with a mercury vacuum pump, making fulminate of mercury for explosives, taxidermy, making mercury compounds and antifouling paints, and even the making of a sort of cosmetic from mercury and Epsom salts. Kober has also seen mercurial poisoning in coating electrodes with amalgam and making solder containing mercury for dry battery work.

Two quite extensive investigations into industrial mercurial poisoning have been published in the United States, but unfortunately both are from New York and northeastern New Jersey, so we really do not know anything about this condition in the rest of the country. The first investigation was published in 1912 and was made by Mrs. Linden Bates for the National Civic Federation (2). This investigation covered most of the industries enumerated above and led to the discovery of ninety-four cases. Over 18 per cent. of these came from thermometer makers. These people have to seal the glass tubes of the thermometers with heat. The glass often bursts and the mercury volatilizes. In the Bausch and Lomb factory they have

this well arranged. The workman slips his arms through openings in the furnace in which the tubes are sealed and there is an exhaust to keep the air in the furnace from escaping.

Four of the patients from the Civic Federation list were making incandescent lamps. The risk comes here from the use of the Sprengel vacuum pumps which may break and scatter mercury. These pumps are now being gradually replaced by rotary pumps, which are much less likely to break but which have to be cleaned, and therefore there is still risk of poisoning. The pumps used for making Roentgen-ray tubes have even more mercury.

Mercurial poisoning in the making of fulminate is rare. I have heard of but one case that developed during the war, though of course there may have been more. Teleky (3) in Kober and Hanson's *Diseases of Occupation and Vocational Hygiene*, describes the fire gilding of objects which are to be subjected to outdoor conditions, such as church crosses, gilded ornaments, and buttons for naval uniforms. He thinks this work more productive of poisoning than any other industrial process in which mercury is used. The object to be gilded is first heated with mercury to form an amalgam, is then smeared with mercury nitrate or cyanide and painted with the amalgam, and heated to volatilize the mercury. There is no need to point out the danger in such a process. Fortunately fire gilding is being supplanted by galvanoplating. The Civic Federation found three cases from this source.

Another industry that involves the use of mercury amalgam is the MacArthur-Forrest cyânide process for the recovery of the precious metals, already spoken of under arsenic. Mercury, according to Teleky, is sometimes used in the preliminary stage for this process, to form an amalgam with the gold and silver. Teleky has heard of no mercurial poisoning in this field, but of course we know that pretty widespread poisoning can go on in some of our more remote industrial centers where all the medical work is in the hands of company physicians, without the world at large knowing of it. This problem would make an interesting subject of research.

According to Edsall (4), mercury amalgam caused poisoning in two dentists who had the habit of rubbing it up in the palms of their hands.

But the most notorious mercury trade is the making of felt hats and the preparation of fur for felt hats. Treating fur (rabbit, beaver and muskrat, chiefly,) with nitrate of mercury makes the laminæ of each hair separate from the cylinder and stand out, thus changing a smooth hair into one with little prickles all along its length. This greatly increases its capacity to felt, that is, to form a closely tangled mat. It is the use of mercuric nitrate in this way that has made felt hat manufacture one of the most conspicuously dangerous trades in Europe and has led both the French and British to seek for a substitute for the mercurial salt. This search was, of course, interrupted by the war. In this country, I doubt if the public had ever heard of mercurial poisoning in the making of felt hats before 1912, the date of the publication of the Civic Federation report, and if physicians knew of it they kept the knowledge to themselves. The Civic Federation found ten cases of this form of occupational disease among hatters' furriers and eighty among the makers of felt hats. Their investigation, as I remember it, covered chiefly the industry in the Oranges in northern New Jersey. Since then, the very vigorous head of the Department of Labor of New Jersey, Colonel Bryant, has instituted many reforms in the hat industry, and a very different state of affairs now exists.

In 1914 Dr. Louis Harris (5) of the New York City Department of Health made a thorough study of conditions in the furriers' and hat making trades in that city, and examined for mercurial poisoning large numbers of the employees. The men in the hatters' fur trade treat rabbits' fur with mercuric nitrate, a process known as carrotting. Each person, who subsequently handles the hairs, is exposed to mercurial poisoning. Among 266 men in the New York shops, Harris found that 212 were exposed to mercurial poisoning in carrotting the fur, in drying it in ovens, in cutting hair from the skins, and in sorting out the long hairs and packing the fine ones. Basing his diagnosis on evidence of gingivitis and violent muscular tremors, Harris decided that there were at least forty clear cases of mercurialism

among these 212 men and probably twenty more. No less than ninety-one had muscular tremors and they were violent in seventeen.

This carrotted fur is bought by the hatters and put through many processes, some of them attended with a great deal of dust, some with steam and moist heat, some with vapors of the wood alcohol used in the shellac. Conditions in such factories are usually very bad, and many features tend to bring about ill health aside from the presence of the salt of mercury. Harris examined 158 hat makers and found eleven with advanced arteriosclerosis, twelve with marked anemia, and seven with muscular tremors.

It is interesting to note that the amounts of mercury used in felt hat making are small, and that in the finished hat there is only 0.138 per cent. of mercury. Analysis of all the materials used, following them through the different stages, yielded as the highest content, 0.17 per cent. The heat volatilizing the small quantities of the mercury used in ill-ventilated rooms, is evidently largely responsible for the poisoning, and it is also evident that very small doses are enough to bring about serious results.

The most advanced cases of industrial mercurialism are those described in the report of the Civic Federation, for they followed up old cases, men too far gone to keep on with the work. Palsy—meaning incomplete paralysis—was found in three patients; complete paralysis in one limb in four cases. Four had multiple neuritis, two ataxic gait, and one man had died of hemorrhage from the nose, mouth and intestines. All these were different patients. The worst case was in a boy of only 18 years, who after two and a half years' work, was quite incapacitated, shook constantly as if in a violent chill, could not feed himself, could not pick up anything and hold it, could not go downstairs except by sitting down and sliding, and had tremor of the tongue to such a degree that he stammered in talking. He had also impairment of memory.

There were two cases of psychosis among the Civic Federation cases, and though Harris did not find any pronounced symptoms of this kind among those he examined at work, he noted nervousness and irritability, with abnormal self-consciousness on the part of some, one man throwing down his work and declaring he could do nothing if he were looked at. Edsall reported a case of psychic disturbance of this kind, with constant apprehensiveness, in a man who had spilled mercury on his desk and on the floor of his bedroom.

CARBON DISULPHIDE

This is one of the trade poisons to the study of which Americans have made noteworthy contributions, though not in as great number as have the Germans, French and British. This is not because of neglect in the United States, but because we do not use carbon disulphide in industry as much as do foreign countries. Carbon disulphide is the substance which has made the rubber industry in Germany and France so notoriously dangerous, and though the British rubber industry seems to be carried on more like ours, still there are some quite shocking pictures of this kind of poisoning in British literature also. Carbon disulphide may be used to vulcanize rubber by means of sulphur monochloride, the carbon disulphide acting as a solvent which allows the vulcanizing agent to penetrate. This seems to be the common method of vulcanizing in France and Germany. Just a little while before the war, I came across a report of the German Factory Inspection Service, in which it was stated that a certain rubber factory in Prussia had introduced a vulcanizing machine which would displace 150 women vulcanizers. This was a larger number of persons handling carbon disulphide than I had found in thirty-five large American rubber factories employing more than 100,000 persons.

We use sulphur flowers and heat in vulcanizing the greater part of our rubber goods. Carbon disulphide with sulphur monochlorate is called in the trade the "acid cure" or the "vapor cure," and is used to splice the inner tubes of tires, to vulcanize dipped rubber goods (such as surgical gloves, toy balloons, bathing caps, finger cots, more rarely hot water bottles and nipples), and also thin sheeting for rubber dams and cheap rubber clothing.

Inner tubes are painted with carbon disulphide; very thin goods are hung in a vapor chamber, and heavier goods are dipped in it, the last method being, of

course, attended with the greatest amount of exposure. The cases of poisoning reported in this country are not many. They come from New England, New York, Pennsylvania, Indiana, and Ohio. The earliest ones are described by Peterson (1) in the *Boston Medical and Surgical Journal* for 1892, but the cases occurred in 1887. Peterson waited several years before publishing his cases in the hope of adding to the number, but finally gave up, baffled by the difficulty of getting past the secrecy that surrounds many factories in which dangerous compounds are used. These cases of Peterson's, three in all, came from a rubber factory near New York City. The men were all sent to the Hudson River State Hospital for the Insane, suffering from acute mania. The second patient was not entirely irrational; in fact, he could control himself to a great degree and could give a perfectly rational account of his work and its effects. All had been exposed to carbon disulphide, all were young men between 23 and 31 years of age, and according to the story of the second, five or six other men had gone insane from the same work. The acute mania subsided after a few weeks, to be succeeded by increasing dementia, then slow recovery. One man was discharged cured after seventeen months, the second after twelve months, and the third after two months. The second patient, the mildest case, had the hysterical symptoms described by Marie (2), who always insisted that carbon disulphide is only the exciting cause of hysteria in persons already predisposed to it. This man had terrible dreams, was depressed and melancholy, believing at times that he had lost his lungs and his tongue, his memory was impaired, and he had muscular tremors. He said, as do most such patients, that the first effect of the fumes was to make him hilarious and talkative, then depressed.

That same year, 1892, Bard (3) reported two cases from California, not industrial in origin, for the men were poisoned by sleeping in a low bed in a room next to one which contained a leaking can of carbon disulphide. The fumes are heavy and fall to the floor. One of these men in his mania thought he had been wronged and murdered his supposed enemy, shooting himself afterward. The other patient, also maniacal, recovered.

In 1904, Jump and Cruice (4) of the University of Pennsylvania published an interesting article on carbon disulphide poisoning in artificial silk workers. The history of one of these cases is so typical that it is worth quoting. The silk is made by treating cellulose first with caustic soda, then, in a closed tumbling vat, with carbon disulphide. At the completion of the reaction the carbon disulphide is largely, but not entirely, driven out with a blast of air. When the contents of the vat are dumped to be again treated with caustic soda, quite a little fume of carbon disulphide escapes. In cleaning these vats, too, the men are exposed to fumes. One of Jump and Cruice's patients said that when he went to work in the morning he felt exhilarated and jolly, though when the fumes were thick, as in cleaning a vat, he might be almost overcome and obliged to go out of doors. When he reached home in the evening he was morose and irritable, could eat nothing with pleasure because everything tasted of carbon disulphide. Presently he began to have severe headache, vertigo, weakness, first in the arms and then in the legs, until at last he could hardly climb stairs. He had muscular tremors, slight ataxia in the legs, a weakened grip, could not get up from his knees without help. His memory and his vision were impaired. His red blood count was 5,000,000, but his hemoglobin was only 40 per cent. This patient recovered.

Heath (5) of Indianapolis saw a case of carbon disulphide poisoning in a woman who had spliced inner tubes for two months and had been obliged to stop work because of her increasing nervousness, irritability, insomnia, weakness of muscles, and emaciation. She came to Dr. Heath complaining of a mist before her eyes and though at the time her vision seemed normal, when he examined her some months later the loss of vision was very marked and was not improved by glasses. The patient's general condition, meantime, had improved very much. The affection of the eyes, Dr. Heath believes, is at first a congestion followed by atrophy of the optic nerve. This agrees also with the experimental studies made by Birch Hirschfeld.

When I studied the rubber industry in 1914 (6) I found a few histories of carbon disulphide poisoning, not related by physicians—they seemed never to have

heard of it or to know what its effects would be—but by foremen. One case was in a Detroit factory in a splicer of tires. This patient became maniacal suddenly, was sent to an insane asylum but recovered after a few weeks and came back to work in the same factory though in another department. A foreman in a dipped rubber goods factory had had so much poisoning among his men that he had instituted a system of alternating employment, letting men stay in the fumes only a few hours at a time. During the preceding year this foreman had had twelve men who had felt the effects in some way, headache, giddiness, indigestion, loss of mental power or of memory, or muscular weakness, especially in the legs. Some patients complained of excessive sleepiness and would drop off to sleep the moment they sat down, others could not sleep. Three had had more pronounced symptoms. One of these, after eighteen months work, was paralyzed. His legs were so weak that he could barely get about the house and his arms were entirely helpless so that his wife had to dress and feed him. This condition lasted for several months, how long the foreman did not know. A second man had worked only a month when he began to get very excitable, talking irrelevantly and wanting to argue about everything. The foreman, familiar with these symptoms, advised him to stop work, which he did and recovered. The third man, also, had worked only a month when he showed signs of mental disturbance. This man was a Hungarian and spoke no English so that the foreman did not know anything was wrong till one day he suddenly became very much excited and unmanageable. He was sent home, and his wife reported that he acted so strangely that she took him to a doctor, to whom he told a long rambling tale about lumbering down the river and did not know he had ever worked in the rubber factory. The foreman thought that this man had recovered. The plant, in this instance, had more fumes from the dipping tanks than any I visited. These last three cases illustrate Laudenheimer's (7) statement that a case of carbon disulphide psychosis develops after a very short exposure, while a paralysis is slower in appearing.

Hayhurst (8) in 1914 found only about 1 per cent. of the 30,000 rubber workers in Ohio exposed to carbon disulphide. This figure includes persons making rubber cement for the repair kits, to which carbon disulphide is commonly added.

PHOSPHORUS

Phosphorus poisoning is, we hope, a thing of the past in our country. We have had a curious experience here. While the phossy jaw of match workers agitated every European country for a decade, was the subject of many eloquent protests, was debated in parliaments and finally made the ground for an international agreement for the abolition of the use of white phosphorus, we went on for years serenely sure that we were quite free from this peculiarly painful and crippling industrial disease. Then, when we were finally shocked into consciousness that our immunity was only fancied, we acted with a promptitude which does not always characterize us, and passed a federal measure to accomplish the same result as that obtained by more direct means in European countries.

I remember quite well my surprise when John Andrews of the American Association for Labor Legislation told me in 1910 that he was investigating phosphorus poisoning. I had, at that time, been speaking on industrial poisons for two years, and had always assured my audiences that the match industry in this country was carried on in such a way as to make phossy jaw impossible. Mr. Andrews told me then that the investigators for the Bureau of Labor, in the course of the extensive inquiry which the government made into the conditions of women and children in industry, had come upon some sixteen definite cases of phosphorus poisoning and had heard that it was far from being a rarity among match workers. As a consequence, he had been asked to make an investigation under the auspices of his association and of the Bureau of Labor. We all know the result—his discovery that in the fifteen factories which he visited (I think there were only sixteen in all, in the country), white phosphorus was always used and that 65 per cent. of all the operatives were exposed to its fumes. Among the 3591 employees, 1253 were women, and of these 95 per

cent. were so exposed, while of the 314 children under 16 years of age, 83 per cent. were exposed (1).

An investigation which Mr. Andrews made into the homes of the workers in three factories, revealed a total of eighty-two cases of phosphorus poisoning. In two factories, at least eight perfectly authenticated cases had occurred in one year, and probably three more. In one small factory records were secured of more than twenty serious cases during the past thirty years, many of the patients requiring the removal of an entire jaw. One of the most modern of the factories yielded records of forty cases; fifteen of these patients had suffered permanent deformity through the loss of one or both jaws. In all, the records of over 150 cases were secured, four of which were fatal. Some of Andrews's cases deserve special mention, coming as they do from an industry which was supposed by everyone to be quite free from occupational disease. One man lost both bones of the upper and lower jaws, and lived on liquid food for the rest of his life. He had a horribly fetid discharge. In another case, suppuration extended to the bones of the orbit, and the patient lost his eye and finally died after great suffering. A woman was so frightfully disfigured that she shunned everyone and became melancholy and eccentric. Andrews also found instances of the *fragilitas ossium* described by European observers.

The earliest American case seems to be one treated in the Massachusetts General Hospital in 1851. A patent for making friction matches had been granted to a Springfield manufacturer in 1836. The date of the invention of lucifer matches is given as 1833, and the first cases of phosphorus poisoning in Austria appeared, or at least were described, twelve years later. In America, we seem to have made matches for fifteen years before recognizing the effects of phosphorus. The Boston case of 1851 was admirably worked up and the hospital record is very interesting. This record describes a state of necrosis very far advanced, a swollen jaw, bloated face, eyes dull and staring, breath very fetid, and half a dozen fistulous openings along the lower jaw discharging offensive pus. This case was very typical in its onset and termination as well as in the lesions produced. The onset was slow, the man having worked fourteen years making paste and dipping matches with no trouble at all till eighteen months before he came to the hospital with a pain in one of the lower incisors. He lost the tooth and then went back to work. It is the general verdict that going back into the fumes of phosphorus with an extraction wound not fully healed greatly hastens the course of the disease. Later entries in the hospital record of this patient show extension of the process in the upper jaw and an increasing toxemia from which he died six months later.

Phosphorus poisoning is much the most conspicuous and dreaded of the industrial poisons and has caused more agitation, first for control and later for abolition, than all the others put together. Yet phosphorus does not affect more than a small proportion of persons exposed to it, and its mortality is only 15 to 20 per cent. It is, however, exceedingly painful, and so disfiguring that everyone can see the effects. Moreover, the offensive character of the discharge makes life with the victims almost impossible. I remember Miss Jane Addams telling me that in 1888 she went to a great mass meeting in London to protest against conditions in the match industry, and that there were a number of girls with horribly deformed faces on the stage to show the audience just what the effect of phosphorus was. I often think that if lead poisoning did all of its work on the face we should have been rid of it long ago.

I think you probably all know how we got rid of white phosphorus—by the passage in 1912 of the Esch law, which placed a prohibitive tax on white phosphorus matches. In 1913 their importation became illegal, and in 1914 their export. At the same time the Diamond Match Co., which held the patents for the manufacture of sesquisulphide matches, threw open to the whole country the use of the process, thus making it possible for all to use the safe methods.

So far as I know, white phosphorus is used now very little in American industry. We do make phosphor bronzes, and an analysis of these bronzes, published in *Metallurgical and Chemical Engineering* in 1914 shows that they contain from 0.068 per cent. to 0.813 per cent. of phos-

phorus. No case of poisoning has been reported from this industry in America, but it is well to bear it in mind. Kaup (2) found a case in Austria, and, though the proportion of phosphorus in the bronze the man was working with was only 0.76 per cent., yet enough phosphurretted hydrogen was given off to poison him.

Ferrosilicon may give off phosphurretted hydrogen as well as arseniuretted, as reported by Glaister (3) at the International Congress for Industrial Hygiene in 1910. We used white phosphorus last summer in the making of an incendiary projectile. I heard of no trouble from its use in this way and probably it was not continued long enough for any cases of poisoning to develop. Occasionally one is told of phosphorus in connection with the manufacture of fireworks, a purpose for which it seems to be used in Italy. The New Jersey Department of Labor found young girls and boys working in a place making fireworks, where the phosphorus was used with great recklessness, an Italian being the proprietor. They tell me they have been on the outlook for this sort of thing ever since.

CARBON MONOXIDE

Industrial carbon monoxide poisoning is greatly on the increase in the United States because of our increasing use of producer gas in furnaces and because of the increasing use of motor cars with their poisonous exhaust gases. American literature has had a good deal of material, of late, on this form of poisoning, especially since it has left the ranks of labor and has climbed up into aristocratic circles, via the automobile and the private garage. There are many reports not only of fatal acute cases, but also of the mental and nervous symptoms which persist long after acute symptoms have disappeared. We have also the experimental work of Yandell Henderson (1) on this subject.

It may be interesting to enumerate a list of the occupations in which serious if not fatal poisoning has occurred in the United States. Of course, the steel industry with its enormous blast furnaces stands easily at the head. Only last fall, in the course of cleaning out a great furnace in the Jones-Laughlin plant near Pittsburgh, almost 100 men were overcome with this gas and twenty-five died. The walls of the furnace were said to be impregnated with it. Gassing is a very familiar phenomenon at our steel works in South Chicago and in Gary. It is also encountered, though to a less extent, in the zinc smelters in Illinois, where producer gas is used for heat, and here it is also said to be present in the bag house, where the sublimed oxide of zinc is collected. It is quite common in the great copper works in Perth Amboy. It is encountered in the making of coke by-products, in glass works, in laundries, in making illuminating gas, or in using illuminating gas as a source of heat. Edsall quotes the statement of a physician in charge of a great city gas works that he had 500 cases of carbon monoxide poisoning. The dangerous processes in the foundries consist in cleaning out mains and furnaces when they are cold and the gas lies in the dust, but accidents also occur from escaping gas when anything interferes with complete oxidation and complete combustion.

Rarer accidents have been reported by Albaugh (2) of the Division of Industrial Hygiene of the Ohio State Health Department. One accident, involving the poisoning of fourteen men and the death of three, was in a barracks erected for a construction gang on a great heap of cinders, in the depths of which slow combustion was going on, permitting carbon monoxide to seep up through the floors of the sleeping rooms. A similar case from Illinois was reported by Apfelbach of the Factory Inspection Department. Two men died from poisoning after raking over a heap of hot cinders. Another was told to me in Perth Amboy. The physician in charge had called the case one of marsh gas poisoning in a laudable attempt to shield the company, and defended his diagnosis on the ground that the plant was built out in the marshes. But the man was digging up heaps of hot ashes and cinders. H. C. Gardner in Bulletin 11 of the Educational Bureau of the Paint Manufacturers says that he has found carbon monoxide in the vapors from drying paints, and he believes that the lead poisoning described in people who are made ill by sleeping in freshly painted rooms is probably carbon monoxide.

Testing motor cars in the great factories caused much poisoning at first, and is still

hard to control. It was said at a meeting of the American Public Health Association that the Ford Motor Co. used to have three or four men a day overcome in the testing department.

Industrial carbon monoxide poisoning is chiefly chronic, only exceptionally acute, but so dramatic are the effects of acute gassing with carbon monoxide that it is not to be wondered at that these cases have utterly overshadowed the effects of repeated inhalations of small doses. McGurn (3) has reported two cases of typical multiple sclerosis in furnace tenders, who breathed small quantities of this gas for long periods. Hitchcock (4) of Detroit reports a case furnished him by Albaugh of the Ohio Industrial Hygiene Department. The man was a combustion engineer who worked constantly for years in a small and ill-ventilated laboratory with many gas jets. Three years before coming under observation this man had an attack of unconsciousness and fell from his chair. After this he had repeated attacks of unconsciousness, and when he sought advice these attacks were coming on about once a week. In the interim he had frequent lapses of memory and would talk incoherently. Blood examination showed an increase of red cells and of large mononuclears.

I suppose the largest number of people exposed to chronic carbon monoxide poisoning are to be found in the tailoring trade, from the naked gas jets used to heat the irons; in printing shops, from the gas used to keep lead melted in linotype pots and other metal pots; in bakeries and laundries, where gas is used for heating and the fumes not carried off; in soldering, where gas jets are used for melting, and in new buildings, where charcoal burners, called salamanders, are used to dry out the walls. So far as I know there have been no blood examinations made in this country to determine the degree of anemia caused by long exposure to small quantities of carbon monoxide. Grawitz found a high degree of anemia in bakers and tailors.

There is evidently a stage in chronic carbon monoxide poisoning which is characterized by a polycythemia. Karasek and Apfelbach (5) of Chicago examined the blood of sixty-eight steel workers and found that practically all the men exposed to blast gas had an increase of red corpuscles, running from 5,500,000 to 9,600,000. No nucleated or abnormal forms were found. These same observers discovered a loss of muscular strength in mill workers exposed to this gas. They tested with the ordinary hand dynamometer 400 cases, selected as strictly comparable, men between the ages of 20 and 40, employed by the steel company and exposed to gas; controls employed by a car company and not exposed to gas. The average strength of the steel men was 117.13, that of the car company men 146.11. The authors commented on the fact that if this loss of power is due to carbon monoxide, it points to a large economic loss in the numerous industries where workers are exposed to this gas.

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MEDICAL INSPECTION OF FACTORY EMPLOYEES*

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MAKING and keeping physical records of industrial employees has been found of such value that very few of the larger employers of labor are without an adequate welfare department, which includes the services of physicians and nurses.

This meeting is interested, of course, in the work of prevention of tuberculosis, but tuberculosis is only one of the many factors of danger that can be lessened by an adequately administered health service department.

My industrial health service work at this time gives me daily observation of some 3000 employees, and two hours each day of my time are spent in making physical examinations. When there is a vacancy in any department, the employment office receives notice of such vacancy, and out of the available applicants each morning sends the selected new employees to the hospital for examination. The examination cards are filled out by two women assistants who have been especially trained to make certain examinations and observe certain defects. The examination records show the name, age, residence, civil condition and previous occupations of the applicant, together with a list of past accidents and of previous sickness. An inquiry is made as to the occurrence of consumption, diabetes, insanity or cancer in the family, and if there has been any tuberculosis, a further inquiry is made as to any active cases or as to the presence of a consumptive in the house where the applicant is living. Inquiry is made as to rheumatism, tonsilitis, pneumonia, and rectal troubles. Women applicants are asked concerning their pelvic histories, menstrual conditions, pregnancies and labors, especially inquiry being made into histories of instrumental deliveries, lacerations, painful periods and varicose veins.

The applicant is weighed, and measured for height and chest expansion. The reflexes are tested for evidence of organic nervous diseases. The eyes are tested for acuity of vision. The throat, tonsils, teeth and gums are inspected and a memorandum made of any evidence of goiter. All defects found are underlined in red on the history card, and when this history and examination is completed by the nurse, the card and the applicant are sent to me for further examination. A specimen of urine is taken for the purpose of finding acute cases of gonorrhea in those under thirty-five, and evidence of Bright's disease or diabetes in those over that age. Flat-feet, rupture, goiter or any deformity is carefully examined as well as the heart, lungs and abdomen. Each applicant brings from the employment office a slip which states the kind of work for which he or she has been selected, but no persons are given work in any part of the factory or office unless they are physically fitted for such positions. Applicants who are mental defectives or epileptics or who have acute venereal diseases or active tuberculosis are not considered for employment in any department. Our records show that we have accepted in the last year 137 employees with organic heart disease, but in all instances such applicants are given light work and few, if any of them, are permitted to do piece work, since piece work causes a nervous tension which affects the heart action both directly and reflexly. No applicant with hernia is accepted unless he wears a properly fitting truss. Our records show that 263 employees belong to tuberculous families, but if any employee is living in a family where there is an active case of tuberculosis, the environment of that employee is investigated by the visiting nurse and recommendations are made which will limit the chance of the employee himself becoming infected. If there is an active case in a boarding or rooming house or even in a private family, the employee is

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requested to make a change when proper precautions are not taken in the household. The nurse is expected to investigate every case of illness among the employees, and employees who are neither late to work nor absent except for sickness receive a bonus of 10 per cent. of their wages each month. Much information has been collected by the nurse during her house visits to employees while checking up these bonus absentees. Several cases of tuberculosis occurred among the employees when I first began my work, and two individuals sued the company, alleging that they had been made ill by their work. One was a painter, who had worked for the company four years, and three of his family had died of tuberculosis in that time. Another had worked as a tester in a room where there were some storage batteries, and he alleged that the fumes from the batteries were responsible for his illness. This man had had a good doctor, whose advice he had, unfortunately, not followed, for his physician had made a diagnosis of tuberculosis two years before and had advised him to get out of factory work entirely. Instead, he married and kept on with his work. I know of no employees who have died of tuberculosis in the past two years.

For over two years the company has had a relief association which, for 10 cents a week, pays $6 a week sick benefit and $100 death benefit. This relief association was, at first, open to all employees without restrictions, and as a consequence was rather an expensive experiment. Now all new members must pass a second physical examination unless they make application within a week after their examination for employment.

A report of the work of the Remy Hospital during 1918 shows that only forty-five employees out of nearly 3000 were injured seriously enough to be laid up more than seven days. Seven thousand, one hundred and seventy-nine visits were made by employees to this hospital for medical advice or attention, and one morning during the recent influenza epidemic 113 employees came to the hospital for prescriptions, advice and temporary relief.

One of the greatest expenses in industry is the cost of labor turnover, and nearly 4500 new employees were examined to keep 3000 positions filled. In one department the work is of such a character that it costs $100 to teach a new employee to become proficient. The work is strenuous, requiring the employee to stand and the pay is accordingly large. During the six months prior to the establishment of compulsory examination before employment, twenty-five employees asked for transfer to other departments, and this transfer cost the company all the money which it had invested in training these employees for their special work. Since physical examination before the hiring of an applicant has been instituted, many applicants, for physical reasons, are not permitted to work in the departments selected for them by the employment office. Suitable positions, however, can nearly always be found for these sub-standard individuals.

Our greatest number of rejections occurs among women. In the health service work among the women employees and in their examinations, I am assisted by a most competent woman physician, who also gives two hours a day to this work. Of course, the innovation of work of this sort in any community is bound to meet with some opposition. We have applicants of both sexes who refuse to give us a physical record and, when such is the case, work is refused them. Twenty per cent. of all applicants have defective eyesight, 40 per cent. have bad teeth, 25 per cent. have bad tonsils, and probably half of the women give a history of menstrual suffering and of nervous disturbances. Goiter is so common that a special investigation and some research work upon this subject is planned for this year.

The question of venereal infections is the greatest problem in every industry. We can refuse to employ applicants if they are infected when they apply for work, but what to do with infected individuals and how to discover the presence of infection after persons are employed is of even greater importance than the tuberculosis problem. In one week recently, three cases of supposed rupture came for examination and were found to be cases of gonorrhea with inflammation of the glands in the groin. Three soldiers, who had been out of the service only two weeks, came in for examination and all had acute gonorrhea, which they said, they had obtained from the same girl a week after

being discharged from the army. If men, such as these three soldiers, knew that they would be refused employment in any company if they were venereally infected, it is my personal opinion that such knowledge would diminish the number of venereal cases occurring, in the same way that the Development Battalion reduced the number of infected cases in the army.

Within the factory, all foremen and forewomen are instructed to send a memorandum to the hospital when any employee shows evidence of any special loss in weight, cough, lassitude, or reduction of ordinary efficiency, and to report all skin diseases, sore throats, and any other physical disturbance which they think should be investigated. In this manner, several employees with incipient tuberculosis and employees with suspicious pulmonary signs have been given leaves of absence with requests to put themselves under the care of competent medical advisors. Several such employees have received financial assistance from the company in addition to the $1 per day Relief Association benefit. The company provides no outside medical attention, and an employee's idea of competent medical advice ranges all the way from Chiropractice to Christian Science, and only too frequently employees see the type of doctor who is too busy to make an examination or who does not know enough to find anything abnormal if he did. The average doctor never examines the teeth, the tonsils, nor the gall-bladder, and yet bad teeth, infected tonsils and infected gall-bladders are responsible for as much human suffering as any other single disease. Our plan for education aims to teach employees that the pus from bad teeth which is absorbed and swallowed with their food and saliva, carries infection through the intestinal tract and to all parts of the body. Infected tonsils are a frequent lodging place and point of entry into the system, not only of tubercle bacilli, but also of the germs which cause rheumatism and organic heart and kidney disease. Applicants with infected teeth showing bad neglect are given employment conditional on their securing proper dental care. Individuals with defective eyesight who apply for work requiring close vision, must be fitted by a competent oculist. Unfortunately, half of those who are wearing glasses have been fitted by a mechanic only.

In accordance with the plan of some of the larger industrial concerns, an educational campaign is to be inaugurated by issuing a series of pamphlets, containing in a few words the vital facts concerning many of the important enemies to human efficiency. A list of these includes tuberculosis, gonorrhea, syphilis, rheumatism, appendicitis, pneumonia, constipation, infected tonsils, neglected teeth, eye-strain, blood-poisoning, personal uncleanliness, badly ventilated sleeping rooms, tobacco heart, all work and no play, etc.

The company has already provided for recreation and has an adequate suburban clubhouse where any employee is welcome, and where membership, costing $3 a year, gives opportunities for music and dancing and for free instructions once a week in all the latest dances. Lunches or dinners may also be enjoyed at the club at a minimum expense. During the summer there is ample room for picnicking, baseball, tennis, croquet, and other diversions. Plans for the future include a factory restaurant giving a hot noon meal to employees and supper to the night workers.

The modern industrial concern is recognizing the fact that the human machine is a more complicated affair than its most expensive fabrication of steel. The efficiency of this machine depends upon good health, and good health cannot be maintained unless an individual has good food, properly prepared, warm clothes, and sanitary living places. To secure these, proper remuneration must be paid to workers and they must be educated how to spend their wages to the best advantage.

The economic situation created by the world war has given the laborer wages which will not only provide these necessities, but will also permit him to keep himself in proper physical condition if he knows his defects and deficiencies. Industrial physical examinations are showing employees where they are lacking, and are causing the man who is looking for a job to make an inventory of himself, when his employment card shows that he has checked up against him a leaky heart, sugar or albumin in his urine, high blood pressure, or a little fever and a suspicious spot in his lung.

We hope to educate the layman to de-

mand of his physician a competent examination when he asks for medical advice. We hope to keep the tuberculous employee from injuring himself by work and from infecting others who may have to associate with him. We hope to make good health an asset for every individual and to teach the individual that the prevention of sickness and disease is a possibility and that physical disability is a matter of neglect and ignorance and not a dispensation of Providence.

On the credit side of the ledger of every industry that has an efficient health service we find:

1. Diminished labor turnover.
2. Diminished loss of production due to absenteeism.
3. Increased efficiency and lessened cost of production, due to higher grade employees.
4. Diminished industrial liability from accidents, due to elimination of physical and mental defectives.
5. Diminished moral hazard due to the fact that venereal infected employees are only conditionally employed.
6. Diminished labor cost due to the reduction of the excessive overhead charge which results from transferring employees who are working at a physical disadvantage.
7. A hospital and a dispensary place employees in direct personal touch with the entire organization, and show such employees that their company recognizes that healthy individuals are the most vitally necessary part of its success.

BOOK REVIEWS

Effect of Alcohol on Psycho-Physiological Functions. Walter R. Miles, From the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts, 1918

This highly technical monograph supplements that of Dodge and Benedict published in 1915. In the 1915 report from the Nutrition Laboratory the effect of alcohol was noted upon fourteen individuals, measurements being made with a degree of care and a refinement of method heretofore unapproached. Subject VI in this group proved particularly refractive to alcohol and was regarded as the least favorable of the subjects used by Dodge and Benedict. Miles has repeated the former observations upon this man. The dose of alcohol employed was 30 c.c. of absolute ethyl alcohol diluted with 7 c.c. of orange infusion, 1 c.c. of strong infusion of quassia, a slight amount of saccharine for sweetening, and water to bring the volume to 150 c.c. A mixture of the same composition and volume but without the alcohol served as the control dose on normal days.

The technique of observation was as follows: Immediately on reaching the laboratory pulse was counted and general data as to the amount of sleep, etc., during the previous twenty-four hours was secured. Arrangements were then made to measure:

1. Pulse taken eleven times during each experimental hour by means of electrocardiograms from body leads.
2. Patellar reflex recorded on rapidly moving kymograph, both latency and amplitude being measured. Stimuli delivered by pendulum hammers.
3. Sensory threshold for faradic stimulation
4. Reaction time in reading isolated words.
5. Finger movements
6. Voluntary tetanus pulse.
7. Memory.
8. Eye reaction to peripherally appearing stimuli.
9. Eye movements.
10. Protective lid reflex.

As in the case of (1) and (2) all subsequent observations in the series were made by means of very accurate electrical and optical apparatus, the details of which cannot be given space in this review. The first set of observations being completed, the subject was given his alcohol or control mixture and the measurements were repeated in identical order until five hours had passed since the beginning of observation.

The final paragraphs of the report indicate the general nature of the results, which are of interest industrially in the delineation of highly accurate objective methods of observation which might be employed quite as well in studies of fatigue.—*Cecil K. Drinker.*

The Disabled Soldier. By Douglas C. McMurtrie. Director, Red Cross Institute for Crippled and Disabled Men. With an Introduction by Jeremiah Milbank, Vice-Chairman, Committee of Direction, Red Cross Institute for Crippled and Disabled Men. Cloth. Pp. 232, with illustrations. New York: The Macmillan Company, 1919.

The re-education and placement of the disabled soldier is a subject of prime importance and one which has been slighted in medical literature. To those who have only a vague idea of what has been done in Europe and the type of problem confronting this country, Mr. McMurtrie's book will prove easy and interesting reading.

Following a sketch of the past inadequate method of treating the crippled soldier, the author carries the reader by successive chapters through the training of the *mutilé* to his final placement. Special chapters deal with the work done in different countries, going into considerable detail.

The book ends with a most interesting chapter in which America's special problems are considered, and the steps already taken to meet them.

The book is written in clear, non-technical language and will be read with enjoyment by those interested in this fascinating line of work.

The industrial physician will find it stimulating and suggestive as many of the problems discussed are those arising in his specialty.—*W. Irving Clark, Jr.*

Industrial Goodwill. By John R. Commons. Cloth. Pp. 213. New York: McGraw-Hill Book Company, 1919.

Labor goodwill has been developed in this constructive volume into a fundamental philosophy of employment management. Professor Commons has shown that there are two unsound doctrines governing labor policies. From the "commodity" viewpoint, the wage-earner's time is bought at the lowest possible market rates and the employer feels no responsibility for training, health, unemployment, promotion, or general welfare. The other view regards the worker as a machine to which the engineering sciences can be applied. Time and motion studies, standard practice, and premium payment plans are the result.

Under the new régime the human elements in management are given first place. Industrial enterprises succeed over a period of years only because they develop a stable, harmonious working force. This implies a reasonable tenure of position, selection of workers on the basis of peculiar fitness for the task, training for efficiency and for advancement, a voice in management, and safeguards against accidents and occupational disease.

Students of industrial medicine will appreciate Professor Commons' book because of the clear exposition he gives of the place of health in a well-rounded plan for regulating industrial relations.—*Roy W. Kelly.*

Army Mental Tests. Washington, Nov. 22, 1918.

This brief report is designed to give one an idea of the relation of scientific placement of men to military efficiency.

The purposes of the intelligence tests are as follows:

1. In the discovery of men whose superior intelligence suggests their consideration for advancement;
2. In the prompt selection and assignment to Development Battalions of men who are so inferior mentally that they are suited only for selected assignments;
3. In forming organizations of uniform mental strength where such uniformity is desired;
4. In forming organizations of superior mental strength where such superiority is demanded by the nature of the work to be performed;
5. In selecting suitable men for various army duties or for special training in colleges or technical schools;
6. In the early formation of training groups within regiment or battery in order that each man may receive instruction and drill according to his ability to profit thereby;
7. In the early recognition of the mentally slow as contrasted with the stubborn or disobedient;
8. In the discovery of men whose low grade intelligence renders them either a burden or a menace to the service.

The final nature of the tests is not given in this pamphlet. There is an explanation of ratings followed by directions for the use of ratings after they have been obtained. The first of these directions indicates the breadth of view displayed throughout the report:

1. The mental tests are not intended to replace other methods of judging a man's value to the service. It would be a mistake to assume that they tell us infallibly what kind of a soldier a man will make. They merely help to do this by measuring one important element in a soldier's equipment, namely, intelligence. They do not measure loyalty, bravery, power to command, or the emotional traits that make a man "carry on." However, in the long run these qualities are far more likely to be found in men of superior intelligence than in men who are intellectually inferior. Intelligence is perhaps the most important single factor in soldier efficiency, apart from physical fitness.

The ratings had the following interpretation and distribution, as averaged for two typical regiments:

INTELLIGENCE RATING	INTERPRETATION	BALANCED DISTRIBUTION
A	Very Superior	3.5%
B	Superior	7.5
C+	High Average	13.5
C	Average	21.5
C—	Low Average	22.0
D	Inferior	22.0
D—	Very Inferior	10.0

Numerous charts follow, indicating the success of the intelligence rating in judging a man's probable value in the service. These show an excellent correspondence between promised efficiency, as given through the rating, and actual accomplishment.

The report is of value industrially in the promise it gives for the success of large scale experiments in improving industrial efficiency.—*C. K. Drinker.*

BOOKS RECEIVED

Standards of Health Insurance. By I. M. Rubinow, M.D., Ph.D., Executive Secretary Social Insurance committee, American Medical Association, Lecturer on Social Insurance, N. Y. School of Philanthropy, 1912-1915; President, Casualty Actuarial and Statistical Society of America. Cloth. Pp. v, 322. New York: Henry Holt & Company, 1916.

Social Insurance. An Economic Analysis. By Robert M. Woodbury, Ph.D., Assistant Professor of Economics in the University of Kansas, Sometime President White Fellow in Political and Social Science in Cornell University. Cloth. Pp. x, 171. New York: Henry Holt & Company, 1917.

Social Insurance. With Special Reference to American Conditions. By I. M. Rubinow, Chief Statistician, Ocean Accident & Guarantee Corporation; Lecturer on Social Insurance, New York School of Philanthropy; Former Statistical Expert, United States Bureau of Labor. Cloth. Pp. viii, 525. New York: Henry Holt & Company, 1916.

Tuberculosis of the Lymphatic System. By Walter Bradford Metcalf, M.D., Associate in Clinical Medicine, University of Illinois, College of Medicine. Cloth. Pp. 216, with illustrations. New York: The Macmillan Company, 1919.

Manual of Medical Research Laboratory. War Department, Air Service, Division of Military Aeronautics. Cloth. Pp. 255, with illustrations. Washington: Government Printing Office, 1918.

American Red Cross Text-Book on Home Hygiene and Care of the Sick. By Jane A. Delano, R.N., Chairman of the National Committee, Red Cross Nursing Service; Director, Department of Nursing, American Red Cross. Revised and rewritten by Anne Hervey Strong, R.N., Professor of Public Health Nursing, Simmons College, Boston. Cloth. Pp. 334, with illustrations. Philadelphia: P. Blakiston's Son & Company, 1918.

PRELIMINARY PROGRAM OF THE MEETINGS FOR THE DISCUSSION OF INDUSTRIAL MEDICINE AND SURGERY—SEVENTIETH ANNUAL SESSION OF THE AMERICAN MEDICAL ASSOCIATION ATLANTIC CITY, JUNE 9-13, 1919

SECTION ON MISCELLANEOUS TOPICS*

There will be two meetings for the discussion of Industrial Medicine and Surgery—five or six additional papers are being considered. The completed program will be announced in the Official Program.

MEETS IN BREAKERS, EGYPTIAN ROOM—ALL MEETINGS

Chairman—HARRY E. MOCK, Chicago.
Vice Chairman—DAVID L. EDSALL, Boston.
Secretary—OTTO P. GEIER, Cincinnati.

Wednesday, June 11—2 P. M.

Meeting Place—Breakers, Egyptian Room

SYMPOSIUM—SCOPE OF INDUSTRIAL MEDICINE AND SURGERY

Chairman's Address. HARRY E. MOCK, Chicago.

Preventive Surgery, as Demonstrated by Industrial Practice.
WILLIAM I. CLARK, JR., Worcester, Mass.
Discussion to be opened by WILLIAM O'N. SHERMAN, Pittsburgh; CHARLES G. FARNUM, Peoria, Ill., and ARTHUR M. CORWIN, Chicago.

Industrial Medical Practice and Sickness Prevention as a Factor in Public Health.
C. E. FORD, New York.
Discussion to be opened by WILLIAM ALFRED SAWYER, Philadelphia.

The Enlarged Program of the U. S. Public Health Service, Division of Industrial Hygiene and Medicine.
JOSEPH W. SCHERESCHEWSKY, Washington, D. C.

International Aspect of Public Health as Related to Industrial Hygiene.
GEORGE A. SOPER, Sanitary Corps, U. S. Army.

Discussion of Papers 4, 5 and 6.
General Discussion of the Symposium.
Discussion to be opened by FRANCIS D. PATTERSON, Harrisburg, Pa.

Friday, June 13—2 P. M.

Meeting Place—Breakers, Egyptian Room

SYMPOSIUM—SOME FUTURE ASPECTS OF INDUSTRIAL MEDICINE AND SURGERY

Modernizing Our Medical College by Adding Departments of Industrial Medicine and Public Health. OTTO P. GEIER, Cincinnati.
Discussion to be opened by DAVID L. EDSALL, Boston.

Medical Service for the Small Industrial Units.
CLARENCE D. SELBY, Toledo, Ohio.

*From Jour. Am. Med. Assn., May 10, 1919, 72, 1414.

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THE PROBLEM OF ASCERTAINING THE ACTUAL RISE IN MORTALITY CAUSED BY UNHEALTHY TRADES*

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IN the study of industrial health hazards, probably the most difficult problem that presents itself is to arrive at some conclusion as to the actual effect on mortality caused by the handling of industrial poisons, and by working at trades that are burdened with an occupational disease.

To the purely scientific investigator this question has not the paramount importance that it possesses for the practical man who must deal with these figures in the earning of his bread and butter. To the scientist the occurrence of one case of industrial disease is sufficient reason for the institution of vigorous remedial measures, remedial legislation, if necessary, and profound research. This is very properly so, as the ideal condition for which we are all striving guarantees every operative perfect safety from both accident and health hazards in the performance of his work.

The practical man's problem, however, is not of the future but of the present. Take the life insurance underwriter, for example. The occurrence of one or two cases of industrial disease, or one or two deaths from industrial disease is not sufficient reason for him to deny to all the operatives in the plant the benefit of insurance. He must estimate the actual ravages of the disease and charge a rate therefor. In many instances this is still largely a matter of skilled guessing. One of the most prominent examples of a disease which illustrates this difference in viewpoint is anthrax. An enormous amount of research work has been done and a great deal of money has been spent on this disease, but from the viewpoint of the practical man it can be ignored with comparative safety. The cases are so few compared with the number of those who are exposed to it, that its effect on mortality is practically nil. In the Medico-Actuarial Mortality Investigation published in 1913, the class of journeymen tanners returned a mortality materially below the standard and, although the class was small and liable to fluctuation, there is no indication of high mortality from any inherent cause. Experience of individual companies also bears out this conclusion.

There are many reasons for this difficulty in estimating the actual ravages of an industrial disease, all exceedingly hard to overcome. First, there is the problem of labor turnover. It has been demonstrated times without number that working conditions bear a distinct relation to labor turnover. In the factories, therefore, that maintain the most primitive systems and where the problem might be studied to best advantage, the huge labor turnover makes any investigation impossible. It frequently happens that the worst factories will show the fewest cases of industrial disease for the reason that their operatives do not remain long enough to contract it. It is useless to quote figures illustrative of this condition as it has been shown conclusively to exist. It

*Received for publication April 23, 1919

may be stated, however, that during the war, while labor was particularly unstable, the condition was especially noticeable, monthly overturns of 50 per cent. being frequently noted and, in certain plants, going even higher. This condition is a very unfortunate one for the industry from the standpoint of efficiency, but fortunate in that it minimizes the effects of poisons which would otherwise have a free rein in working disastrous results.

The second great cause of difficulty in estimating the ravages of industrial disease is the fact that, in probably a large majority of instances, although an operative may have actually contracted an industrial disease, he dies of some acute malady to which in his weakened condition he is an easy prey. There are industrial processes which may cause disease of practically all the vital organs—lungs, heart, kidneys, digestive apparatus—leading to a weakening of these organs which materially aids the acute plagues, such as pneumonia and typhoid fever, in increasing the number of their victims. This phase of the problem is further complicated by the fact that the victim is frequently no longer employed in the industry which, in reality, caused his death. Many operatives, especially the more unskilled, leave an occupation when they find it adversely affecting their healths.

Remedies have been suggested for these difficulties. A standard state death certificate, giving not only present but previous occupations during a period of several years, is a frequent suggestion. The American Association for Labor Legislation has done some missionary work in this connection. The data available, were such a certificate universally adopted, would undoubtedly be of the greatest value. Sixteen states also compel the reporting of industrial diseases, and as these states cover the largest industrial centres an immense amount of invaluable data is constantly accumulating. This data will show the prevalence of diseases peculiar to certain industries and if properly matched up with the vital statistics will assist materially in the final solution of the problem.

One would suppose that one of the most valuable sources of information bearing on the problem would be the experience of the great life insurance companies themselves. This is true in great measure, but forces are at work which tend toward inaccuracy in these as in other figures. In the first place, insurance companies have to hark back so far into the past to get sufficient exposures on which to base their findings that they do not properly reflect the trend of conditions in the industry. As a practical example of this, any figures giving mortality in the felt hat industry which go back twenty years would not be of great practical value today. Twenty years ago in all felt hat making centres mercurial poisoning was the mightiest of menaces to health and the offices of local physicians were flooded with operatives needing treatment for the condition. Today, with modern appliances for confining and removing the fine mercurialized dust, the dangers have materially abated and in the very best equipped and best managed factories are almost non-existent. The same is true of many other industries.

Of course the error producing factors of labor turnover, instability, etc., are present in the life insurance experience as well as in all other statistics. Furthermore it must be remembered that, in the past, operatives in the hazardous and unhealthy trades have been denied insurance in a number of the largest insurance companies. This is especially true of the old line companies. This state of affairs is rapidly correcting itself as it is becoming more and more the modern life insurance opinion that its benefits should be extended to everyone as fast as the rate necessary to be charged can be ascertained. The industrial companies are in a position to furnish probably the most valuable data owing to the immense number of lives which they insure, and many valuable studies have been contributed to the subject by Dr. Hoffman of the Prudential Life Insurance Co., of Newark, N. J., and by the Metropolitan Life Insurance Co. The experience which will be available with the development of group insurance seems to aim more directly at the problem than any other medium. Insuring, as this plan does, all the operatives of a manufacturing establishment, it gives opportunity for study of actual mortality from the standpoint of the inherent dangers in the occupation both as a direct and as a contributing cause. The experience furnished through this medium will be

subject to the inaccuracies caused by the shifting and instability of labor but it will be possible to overcome this in large measure. For instance, a separate class can be made for purposes of statistical analysis of operatives who have been for a number of years in the same plant, and thus the factor of inaccuracy caused by floating labor can be largely done away with.

Insurance companies have, on the whole, showed the greatest tendency to get together and to compare results of any of the great forces working on the problem of hazard to life. From the standpoint of the life insurance companies there have been two notable examples of this. The specialized mortality investigation of 1903, conducted by the Actuarial Society of the United States, was participated in by thirty-four life insurance companies, each furnishing its quota of exposures. It is of no particular value as applied to unhealthy trades, principally because few of the companies involved had any such exposures to contribute. The only occupations considered, which might be said to involve an industrial disease or which were inherently unhealthy, were steel grinding, glass working, pottery making, house painting and printing, and in most instances the classes were so small that the information could not be depended upon. Other classes of occupations in which the hazard was accidental were taken up and valuable results obtained. In 1913 the Medico-Actuarial Mortality Investigation was completed. This study was conducted by the Actuarial Society and the Association of Life Insurance Medical Directors of the United States; was participated in by forty-three first-class companies, and provided an immense amount of vital data. From the industrial disease standpoint the information obtained, while somewhat more comprehensive than provided by the specialized investigation of 1903, was, in general, subject to the same criticisms as applied there. The classes were generally small and liable to fluctuation. The industries investigated which have a bearing on our problem were: journeymen baking, glass industry, hatmaking, metal grinding and polishing, blast furnaces and rolling mills, coal and metalliferous mining, potteries, house painting, plumbing and steam fitting, printing, stone cutting and tanning. This list does not, of course, even scratch the surface of the industrial disease problem. More work of this character, however, may be expected in the future, and with the spread of life insurance through all industries should have far reaching results.

Although not strictly to the point, some mention should be made of the educational effect of insurance selection on industry. This has been demonstrated in the realm of safety through the liability companies and their various rating boards, which fix a rate according to actual safety conditions in individual plants. Work of this character must also be done in relation to disease and poison hazards by the companies who do group insurance. But with the extension of insurance on the individual to industries whose operatives have, in large measure, been deprived of its benefits, will come an education of the individual worker which should have a far-reaching effect. There may be said to be roughly two methods of selecting life insurance risks from the standpoint of occupation; the individual method, and the class method. By the class method, the particular plant in which the individual works is not taken cognizance of at all and the job is rated the same everywhere. By the individual method, an effort is made to distinguish between plants having up-to-date conditions and those in which conditions are old-fashioned and bad. This is sometimes done by dividing the risks into two or three classes and charging a different rate for each. If Jones who works in Factory A is charged more for his protection than Smith who works in Factory B, both being at the same job, the education of Jones as to the necessity of good working conditions is at once accomplished. As yet this particular method of selection is in its infancy and life insurance companies make very few industrial investigations; but with the development of the new lines of insurance, and with the incorporation into the policies of the special benefit clauses, and with the general interest manifested in the study, a great deal of intensive work along the lines of industrial health is inevitable in the future.

Practically all the great manufacturing companies are to-day keeping health records of their employees and, in many

instances, these records are the most valuable data obtainable on the subject of industrial diseases. Of late years, the tendency to keep these records in a thoroughly systematic way has been growing with leaps and bounds. The laws compelling the reporting of industrial diseases already in force, and the proposed laws forcing the payment of compensation for industrial disease, will make the practice of keeping accurate industrial disease records universal. The growing interest in the problem of scientific employment management will assist in bringing about this result. One of the principal features of a proper employment department is its record system. Here a rigid tab is kept on the health of the plant. This is probably primarily to check up on causes of absenteeism but, if the records are properly made and kept, will aid greatly in showing the prevalence of industrial disease. It has often been noted in plants that do not maintain separate employment departments, that men will stay out for a day or so for illnesses which are undoubtedly due to industrial causes, such as incipient lead poisoning, and yet never report to the plant medical department. Such cases would instantly be detected by the employment department and the operative forced to report to the plant physician.

The federal government during the war gave the campaign for scientific employment management its hearty support. The great army departments, ordnance, quartermaster, aircraft, etc., maintained industrial service sections which preached the doctrine unremittingly. Skilled men were sent out who aided in the formation of properly organized employment departments in plants working on government contracts, and in the great government-owned plants. Courses in employment management were instituted in the universities, and men and women trained to organize and take charge of such departments. Such organizations in plants, working in close co-operation with the medical departments and the safety departments, will undoubtedly produce a mass of data of incalculable value.

With all the agencies which have been briefly mentioned above at work gathering data, it might be supposed that the problem approached a final solution. As a matter of fact, we might approach a very good estimation if all information now being gathered from all sources could be collected and thoroughly digested. There are at the present time a number of federal bureaus and departments which are doing much valuable work along this line. Of course we are all familiar with the work of the Bureau of Labor Statistics of the Department of Labor, and it is safe to say that this bureau has done more in collecting information from differing sources than any other agency. During the war other services were organized which should be perpetuated. It is undoubtedly true that the federal government can do more toward a unity of effort in the solution of any given industrial problem than any other agency, and unity of effort is what is needed more than anything else in the solution of this one.

The Working Conditions Service of the Department of Labor stands in an excellent position to unite all interests concerned with any problem of industrial welfare. It maintains separate departments dealing with industrial hygiene, safety and employment management; it stands in a position to make inspections and to give expert advice and counsel on industrial problems at the call of any organization; it works in close relation to the United States Public Health Service, and the personnel for its inspection and industrial hygiene work is furnished by that department.

The Working Conditions Service is also in constant co-operation with the great government departments which have to do with the industrial problem, such as the Bureau of Mines, the Bureau of Standards, Army and Navy Ordnance, Quartermasters, as well as the Departments of Labor of the individual states. The Bureau of the Census has contributed much valuable information to the subject. The mortality statistics of 1909 were particularly valuable from the standpoint of accident and gave some information from the industrial disease standpoint which will be further mentioned later on.

No better illustration can be given of the difficulties attending even a rough estimate of the rise in mortality caused by an unhealthy trade than a brief outline of some of the data on lead poisoning. This is selected because it is the most prevalent

of all the industrial diseases, many times the number of deaths from lead poisoning being reported than from all other occupational poisonings combined.

The mortality statistics of the Bureau of the Census give the number of deaths annually from lead poisoning. These figures include only about two-thirds of the United States, the rest being outside the registration area.

The table for the years 1910-1916 follows:—

Year	Percentage Registration Area Population to Total United States Population	Number of Deaths
1916	70.2	190
1915	67.1	155
1914	66.8	149
1913	65.1	162
1912	63.2	148
1911	63.1	145
1910	58.3	136
		1085

This table shows that 1085 deaths during the seven years of 1910 to 1916, inclusive, were due to chronic lead poisoning.

In Great Britain during the five years of 1910 to 1914, inclusive, there were reported 2,741 cases of lead poisoning with 174 deaths from this disease or a percentage of fatal cases of 6.3. (The British law provides for the reporting by physicians of cases of lead poisoning in certain lead industries. Painting, which accounts for a great many cases of plumbism, is not covered by the law.) Assuming that the same proportion of fatal to total number of cases holds for the United States, we might roughly estimate that the 804 deaths in the United States registration area during the five years, 1912-1916, inclusive, represent between 12,000 and 13,000 cases of plumbism (exact figure calculated is 12,762).

Localized studies of lead poisoning have been made from time to time. Dr. Alice Hamilton in Kober and Hanson, *Diseases of Occupation and Vocational Hygiene*, gives the following figures:

The Commission on Occupational Diseases in Illinois discovered 578 cases that occurred during the three years, 1908-1910. These were scattered through seventy occupations. Pratt, in a study for the New York State Factory Investigating Committee, discovered 376 cases of lead poisoning which had occurred in New York City during 1909, 1910 and 1911. An investigation into the white and red lead industries in 1911 showed 388 cases of lead poisoning during sixteen months in factories with a pay roll of 1600; sixteen of these cases were fatal; eighty-nine out of 120 of these cases became ill after less than one year's work. Considering the time of this investigation to be practically a year and a half the exposures would be 2,400. This would give a death rate of 6.7 per 1,000 exposed, from chronic lead poisoning alone, taking no cognizance of cases in which it was a contributing cause. This would represent a death rate approximately seven times as great as that from tuberculosis in a healthy locality.

Dr. Hamilton in the same article states the result of further investigations as follows:

Art and Utility Ware: 13 cases among 85 dippers in one year. Among dippers' helpers there were 13 cases among 180 men and boys, and 29 cases among 150 women.

White Ware: 796 employed; 60 cases in two years.

Art and Utility Ware: 304 employed; 63 cases in two years.

Tiles: 304 males employed; 48 cases in one year: 243 females employed; 28 cases in one year.

Bath Tubs: 1012 men employed; 217 cases in 1911.

Lead Smelting and Refining: 1667 cases in one year in nineteen plants employing 7400 men.

Storage Battery Manufacture: 164 cases in 1913 in five plants employing 915 men.

The deaths are not given but we may compare the frequency rate with Dr. Hamilton's figures on the white and red lead industries.

Industry	Frequency Rate per 1000 Exposed
White and Red Lead	243
Art and Utility Ware (Dippers)	153
White Ware	38
Art and Utility Ware	105
Tiles (Males)	158
Bath Tubs	214
Smelting and Refining	225
Storage Batteries	168

The highest rates are where one would expect to find them, with the exception that one would naturally imagine a somewhat higher rate in storage battery plants. In all probability the death rate would follow in the same proportion.

The Occupational Disease Act of Illinois provides for a monthly physical examination of the employees in certain specified industries considered hazardous. For the year ending June 30, 1917, 150 firms were reported on. The kind of plants and the number of cases of lead poisoning discovered in each are given in the following table:

Industry	No. of Firms	No. of Cases
Painting	53	22
Smelting and refining	35	104
Paint manufacturing	26	5
Storage battery manufacturing	10	3
Manufacturing of tinware	6	10
White lead	4	2
Electrotyping	4	3
Manufacturing car seals and bearings	1	..
Telephones and switchboards	1	
Wallpaper and oilcloth	3	
Enameling	1	
Total	150	149

The average number of men examined for the year in these 150 plants was 6,497. The 149 cases of lead poisoning found give a rate of 2.3 per 100 employed for the year.

In New York state, there were reported for the six years ending August 31, 1917, 617 cases, ninety-one of these resulting in death.

More than half of these 318 cases with fifty-nine deaths occurred among the painting trades. The other 299 cases and thirty-two deaths occurred in over thirty-three occupations and industries. The following table gives the more important industries and occupations from the point of view of the number of cases reported therein:

Industry	No. of Cases	No. of Deaths
Painting	318	59
House, structural and ship painting	246	18
Automobile, carriage and wagon painting	15	7
11 other industries	27	1
Storage battery manufacturing	122	3
White lead, paint and colors	55	1
Printing	16	1
Smelting or casting lead, solder, etc.	15	3

All the investigations into lead poisoning reveal the fact that painting is responsible for a large proportion of the cases discovered. The New York state figures just mentioned show that 318 cases out of 617 were among painters. Of the 578 cases investigated by the Illinois Commission, 157 were painters. Forty-two painters were found among 109 cases investigated by Pratt in New York City. Andrews quotes a hospital record in which twenty-eight out of fifty-nine cases were painters and of his sixty fatal cases, forty were painters. In 1913 Hayhurst examined 100 able-bodied painters and found fifty-nine with evidence of plumbism. The figures for Great Britain confirm the American data in regard to lead poisoning among painters.

The law requiring the reporting of occupational diseases in certain specified industries does not apply to house painters. Nevertheless, physicians frequently report cases of lead poisoning among house painters. One thousand, nine hundred and seventy-three cases among house painters and plumbers were reported in the ten years, 1900-1909, inclusive, and 232 cases in 1910, 197 of which were in painters and thirty-five in plumbers. In the ten years, 1900-1909, there were 387 deaths from plumbism among painters and plumbers. Assuming that the proportion of deaths to the number of cases is the same among house painters as among other lead workers, Dr. Legge estimates that over 9,000 (exact figure 9,516) cases occurred among the former during the years, 1900-1909, inclusive. While in the thirteen year period, 1900-1912, inclusive, only 8,523 cases occurred among the reportable occupations, during the fourteen year period, 1900-1913, inclusive, there were reported 421 deaths among those occupations coming under the jurisdiction of the law and in the same period there were reported 427 deaths among house painters and 129 among house plumbers due to lead poisoning. On the basis of the British census returns and the estimated number of cases of plumbism among painters, Legge estimates an attack rate among these workers of 4.8 per 1,000 per annum.

The actual data contained here when viewed as the basis of a mortality rate is exceedingly limited. It shows the undoubtedly high rate of prevalence of the disease. Owing to the very great number

of those engaged in the painting trades, the general figures are confusing. Dr. Legge's estimated attack rate seems remarkably low but probably a large majority of cases are never reported.

The life insurance figures are of very little value. The Medico-Actuarial Investigation showed a mortality of 111 per cent. of the expected for journeymen house painters, and in the printing trades 102 per cent. of the expected for journeymen compositors, and 117 per cent. of the expected for journeymen pressmen. The Metropolitan Life Insurance Co., Industrial Department, Mortality Experience, 1911-1913, inclusive, (occupied white males, ages fifteen and over) shows eighty-one deaths due to chronic lead poisoning, fifty-four of which were among painters.

Practically all of the data, except the United States census figures, are at least eight years old and it must be admitted that industry has made great strides in the last ten years. The United States census figures show a constant increase in the number of reported deaths. This is undoubtedly due to the extension of the registration area, more correct reporting of the cause of death, and increase in the number of operatives engaged. The only year in which we can get a comparison of the deaths as reported by the Bureau of the Census and the approximate number of operatives exposed to the poison is 1910. During that year there were 136 deaths from chronic lead poisoning. The census report for 1909 gives an industrial classification, and we can approximate roughly the number of operatives engaged in trades which expose them to the disease. This is estimated at about 1,000,000. A further approximate separation into the group which is actually exposed to the poison would give about 450,000. Of these, 337,000 were painters and must be treated separately.

To eliminate painters, we must ascertain as nearly as possible their proportion of the deaths. From all the figures quoted above and also from the census returns of previous years, this can be estimated at about 50 per cent. This leaves us, then, 113,000 operatives and sixty-eight deaths. In our group of operatives we still have 47,000 representatives of the printing trades, a group which can be removed as its mortality is small from this cause. A study of the proportion of deaths to be ascribed to the printing trades, shows five to be a probably correct allowance for the year. We have therefore remaining 66,000 operatives and sixty-three deaths, or less than 1 per 1,000 exposed. The actual death rate, even by this calculation, is too small as the figures on the deaths merely represent the area of registration, while those on the trades are taken from the whole country. All the great industrial centres, however, are within the area of registration except the state of Illinois, and in that state the principal industrial centres are within the area.

This study is, of course, filled with inaccuracies and open to every kind of criticism. It bears, however, a certain similarity to Sir Thomas Oliver's figures on mortality among pottery workers exposed to the poison. Eleven years' experience, 1899-1909, inclusive, as published in this report, showed a death rate of about 1 per 1000 exposed.

Taking painters and varnishers separately, the rate sinks to infinitesimal dimensions, even allowing for an enormous dilution. A report published in August, 1918, by Dr. Louis R. Harris, director, Bureau of Preventable Diseases, New York City Department of Health, gives a study of 402 painters. A rate of prevalence of active or latent plumbism of 40 per cent. is reported among this group. Compared with Dr. Legge's estimated attack rate of 4.8 per 1000 these figures are remarkable.

From all the data available we may make the following deductions:

1. The actual mortality from chronic lead poisoning is small, even making all possible allowance for dilution of exposures by lives not dangerously in contact with the poison.

2. We must look to lead poisoning as a contributing cause in ascertaining the actual increase in death rate from this cause, as the rate of prevalence is undoubtedly high.

3. In certain groups such as the white lead workers, as found by Dr. Hamilton, mortality may run high from the direct cause.

4. Painting is not so dangerous a trade as working directly in lead compounds, as occurs in white lead works, glaze rooms in

potteries, smelting and refining works and storage battery plants. The immense preponderance of cases reported in the painting trade is due to the large number of workmen in this trade and to the fact it is a skilled, well-paid trade at which the workers remain, thus eliminating the factor of instability. On the other hand, it is easier to remove or mitigate the dangers in a lead plant than it is in the painting trade, because in the latter instance the amount of exposure is wholly dependent on the discretion of the individual worker.

Miners' consumption ranks on a par with lead poisoning as the most dangerous industrial disease. The information bearing upon it is not so confused and liable to error as the data upon lead poisoning, for the reason that it is a better paid occupation in the main than are most of the lead trades, and because the miner remains rather constantly at his trade. A small amount of fairly direct information is therefore obtainable. As has been pointed out many times, and especially shown by Lanza in his Joplin report, this disease is principally dangerous when the mining is done in silicious ores. In this, as in lead poisoning, the actual rise in mortality must be looked for from other immediate causes than miners' consumption, principally from tuberculosis and pneumonia.

The insurance figures can be considered first. The Medico-Actuarial Investigation found a mortality of 226 per cent. of the expected, according to the mortality table, among miners, other than coal miners. This means, of course, that practically the entire class was composed of metalliferous miners. The class was large, showing 48,400 exposures. The accident mortality was seven times the standard; pneumonia, three times the standard; and tuberculosis, four times the standard. The class included all metalliferous miners and therefore there was some dilution in so far as the effects of silicosis were concerned.

Studies of individual life insurance companies have shown mortalities of over 300 per cent. of the expected and with the death rate from pneumonia and tuberculosis running seven to ten times the average. Mortalities in individual years have been known to go as high as 450 per cent. of the expected.

A study of the health records of a big mining center, where the operations were all in silicious rock, for four years, 1906, 1907, 1908, 1909, showed the following deaths from tuberculosis and miners' consumption among miners: 1906, 59; 1907, 65; 1908, 76; 1909, 82.

In 1911 the figures were checked for six months of that year and found to be running in about the same proportion.

The number of miners in the district was about 11,700 (estimated). The death rate per 1000 from this cause for the four years was therefore:

1906	5.04
1907	5.55
1908	6.49
1909	7.01

Dr. Frederick L. Hoffman in his study of mortality from respiratory diseases in dusty trades, published by the Bureau of Labor Statistics in 1918, gives a study of the mortality among copper miners of Montana for the years 1907-1914, inclusive. The figures given there are prepared with the co-operation of the local Board of Health of the city of Butte. Estimating the number of miners in the Butte district at about 15,000, Dr. Hoffman's eight-year study would return a death rate from respiratory diseases of about 9 per 1000 miners.

In 1904, Dr. J. S. Haldane, F.R.S., made an investigation into miners' phthisis among the metalliferous miners of Cornwall. Dr. Haldane found the death rate from lung disease for three years, 1900-1902, inclusive, as follows:

Age	20–25	25–35	35–45	45–55	55–65
Death Rate	2.7	17.3	33.2	32.2	42.6

These figures run higher than the average of definite American figures, but they are probably more free from dilutions.

Dr. A. J. Lanza of the United States Public Health Service, in his report made January, 1917, estimates a rate of prevalence of 30 per cent. for the disease in the Joplin district.

We can estimate a death rate of from 7 to 10 per 1000 employed, from lung disease induced by the employment, in districts where hard rock mining is carried on. Add to this an accident mortality of about 4 per 1000 engaged, and you have a death rate from hazards wholly incident to the occupation of from 11 to 14 deaths per

1000 employed. These figures are minimum. It is probable the rate runs higher. The average death rate by the American Experience Table of Mortality runs from about 8 per 1000 at age twenty-six, to about 10 at age forty-one. From this the rise in mortality from this particular trade can be readily seen. A very small part of the available material is given here, since the subject has been so thoroughly covered by Dr. Hoffman and Dr. Lanza in their recent papers already referred to.

Of course, the death rates suffer a tremendous diminution when modern methods of ventilation and sanitation are introduced; when the use of water-fed drills supplants the dry, and when modern change houses are built. The very much more definite information as to the actual hazard in mining as compared to the lead trades has been largely accomplished through the close co-operation of a number of the forces working on the problem. It is to be hoped that in the future the principle of co-operation of all interested forces, which was so much emphasized in Washington during the war, will be applied, for the common benefit of all, to the problem of lessening the morbidity and mortality of industrial workers.

THE PATHOLOGICAL AND CLINICAL MANIFESTATIONS FOLLOWING THE INHALATION OF DUST*

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"Failure to inquire respecting the occupation, and a want of knowledge of its working condition and customary ailments, places the doctor at a disadvantage toward his patient, and deprives the latter of the full benefit of treatment."—*Arlidge.*

INTRODUCTION

PNEUMOCONIOSIS occupies a curious position. The term is a familiar one and the nature of the disorder is described in all text-books dealing with diseases of the lungs. In spite of this, however, the term is rarely used by the clinician and only a little less frequently by the pathologist. Furthermore, one may search statistics dealing with morbidity and mortality rates and never find any mention of the condition. In those instances in which the deposition of dust in the respiratory system has actually given rise to pathological changes, the illness or the cause of death is ascribed to secondary changes, such as chronic bronchitis, asthma or tuberculosis. The etiological factor is thus concealed by the use of other terms. The reason that mild grades of pneumoconiosis are rarely mentioned as such is to be ascribed to the fact that a slight degree of pneumoconiosis is present in the lungs of all city dwellers who have reached adult life, the condition under such circumstances being regarded almost as normal. Furthermore, in the presence of the mild type or in the very early stages of the serious and progressive type there are no symptoms, nor is there anything abnormal to be found on physical examination. In the advanced stage the condition is usually referred to as fibrosis or cirrhosis of the lung. Now that the X-rays have come into general use, we have a ready method of determining the condition almost from its incipiency. In the future, pneumoconiosis, with or without fibrosis, will probably be used more generally as a distinctive term. An additional reason for bringing it more prominently to notice is the ever-increasing interest in diseases associated with certain occupations. There can be no doubt but that the whole subject of dust in its relation to disease is in need of more intensive study than has been given to it in the past. Collis (1) has stated that until recent years the tendency has been to consider, as a broad truth, that dust inhalation predisposes to diseases of the chest, of which pulmonary tuberculosis is the chief. "Closer investigation," he

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continues, "is proving that the subject is more complicated; that respiratory diseases caused by dust vary with the nature of the dust inhaled; that although a special type of pulmonary tuberculosis occurs upon the inhalation of certain dusts, it is not associated with the inhalation of all kinds of dust; and that other forms of chest disease, which, though not equally fatal, seriously impair the respiratory organs, are set up by inhaling special forms of dust."

Moreover, as has been pointed out by Pometta (2), it is to be borne in mind that there is scarcely any sickness from industrial causes that cannot develop, with about the same group of symptoms, from some entirely different cause.

The first systematic treatise on the effects of the inhalation of dust was contributed by Ramazzini (3) in 1700. From that time down to the latter part of the nineteenth century, the literature contains numerous references to the subject. Some call attention to the association of certain occupations with respiratory disorders, others have to do with the pigmented areas in the lungs and their possible association with dust. In 1838 Stratton (4) suggested the name anthracosis to designate the changes produced by the inhalation of coal dust. Since that time a number of terms have been used to indicate the particular variety of dust, namely, silicosis, siderosis (iron dust), etc. In addition a variety of popular names have been applied to the dust diseases, the terms used indicating the occupation, as for example, miners' asthma, black-spit, grinders' rot, potters' rot, potters' asthma. The preferable term is that suggested by Zenker—*pneumoconiosis* (πνευμων, lung; Κονις, dust).

Among the earliest observations may be mentioned those by Wafler (1729) and Le Blanc (1775) on the great mortality among the makers of French millstones; and Johnstone (5) on the mortality among the needle pointers of Worcestershire. Thomas Beddoes (6) quotes Linnæus to the effect that cutters of grinding stones all die phthisical before the thirtieth year. Beddoes also noted the frequency of this affection among stone cutters, needle grinders, brass workers and miners, but states that others, as japanners, millers, etc., are not subject to this disease. Beddoes was far ahead of his time in expressing the belief that the high death rate from phthisis among textile workers, tailors, glovers, etc., was to be attributed to confinement and inactivity rather than to dust.

In 1813, Pearson (7) first suggested that dust particles gained access to the lung tissue, and he attributed the dark pigmentation often met with in the lung to the actual deposit in it of particles of carbon or soot derived from the air. Similar observations by Christison (8) and Graham (9) confirmed this view. Virchow, however, denied that the pigmentation was due to carbon and attributed it to organic pigment from the blood. Among those who furnished the proof that the dust actually was deposited in the lung may be mentioned Traube (10), who discovered in the lung of a charcoal burner the angular particles of charcoal dust; Zenker (11), who showed by chemical tests the presence of iron dust and Knauff (12), who demonstrated by inhalation experiments particles of soot in the lungs of dogs. Finally in 1866 Virchow (13), himself, acknowledged that the proof was indubitable.

One of the most interesting and unique studies of occupations is that by Henry Mayhew entitled *London Labor and the London Poor; a Cyclopædia of the Conditions and Earnings of Those That Will Work, Those That Cannot Work, and Those That Will Not Work.* This book, published in 1851, is the first of which I have any knowledge to portray the life of the worker from every standpoint, namely, the character of his work, his hygienic habits, his amusements and his environment—both at work and at home.

Until the discovery of the tubercle bacillus by Koch, in 1882, no distinction was possible between extensive non-tuberculous and tuberculous fibrosis. The term fibroid phthisis was therefore very loosely used and, even at the present time, many cases of non-tuberculous fibrosis are classed as instances of tuberculosis. Tatham (14), in commenting on this aspect of the question, states that "it is certain that much of the so-called potters' phthisis ought properly to be termed cirrhosis of the lung. Deaths from this affection should never be included under the head of phthisis, which term is now restricted by universal

consent to the tubercular malady of that name."

Among others who have written largely on the subject may be mentioned Thackrah (1832), G. Calvert Holland (1843), Arlidge and Oliver in England; Hirt (1871) in Germany; and Hoffman and Kober in this country.

ETIOLOGY

As the result of the rise and expansion of a wide variety of manufacturing interests during the nineteenth century, the attention of sanatarians became more and more directed toward the harmful effects of industrial processes. And of the various harmful agencies none has received more attention than dust. In England, because of the number and variety of her manufacturing interests, the subject has received a great deal of attention. In this country but little thought has been bestowed on the subject until within the past decade. But if we have been backward in realizing the importance of the subject, there is no doubt that the period of apathy has passed. As Hoffman recently remarked, "no nation within recent years has equaled us, either in the quantity or the quality of the work done along the lines of industrial medicine." Much as is known regarding the effects of dust, there is still much to learn and, more important still, there is much to unlearn. At the present time there are too many statements made for which there is no adequate proof. In not a few instances statements regarding the harmfulness of certain dusts have become traditional and continue to be accepted by each succeeding writer on the subject. Many such statements are subject to revision. At the present time far too much of our knowledge regarding the evil effects of dust is based on mortality statistics. While we have no desire to discredit or belittle data of this sort, it is undoubtedly true that mortality returns give a very false idea in many instances, particularly in reference to the organic dusts. As a result of studies of this kind many industries have gained an evil reputation because of a high death rate from tuberculosis among the employees. It has been assumed by most writers that the dust is unquestionably the exciting cause of the tuberculosis. In nearly every instance this assumption is not susceptible of proof. I shall go into the subject of tuberculosis and industrial dusts more in detail in another place.

In studying the effects of dust on the health of the workers, the following factors must be kept in mind: (1) The type of dust; (2) The trade process followed by the worker; (3) The sanitary history of the worker, both personal and in the home.

Type of Dust

That dust is of very varied constitution is well known. First, it may be divided into two main parts, namely—inorganic and organic. The former may be farther subdivided into metallic and non-metallic, while the latter is distinguishable into animal and vegetable. To these two main divisions Hirt (15) added a third, namely—mixed dust.

Inorganic Dust

The inorganic dusts vary greatly in their physical characters; thus the particles may be acicular, or jagged in outline, or oval, or circular. The more jagged and angular the particles, the greater is their power of mischief. Another factor to be considered is the chemical composition of dust. Arlidge (16) has emphasized the importance of density and chemical composition. For instance, density is of great importance; and so is the degree of their divergence as regards organization and chemical constitution. Collis (1) has expressed the opinion that in general dusts appear to be more injurious as their chemical composition differs from that of the human body, or from the elements of which the body is normally composed. Thus it is seen in the case of lime dust (a normal constituent of the body) that notwithstanding its angular form, it is but a feeble irritant to lung tissue. Another example of comparative innocuousness of mineral dust is found in plaster of Paris in its native state. Although its particles have a square or rhomboidal form, with more or less acute angles, they have not the gritty hardness of silicious dust and diffuse readily through water.

In our own studies, cement dust, in spite of the enormous quantities inhaled, seems to be relatively harmless. This is probably due to the fact that it contains little or no silica.

Most of the recent studies on inorganic dust make it clear that metallic and siliceous dusts are the most potent causes of pulmonary fibrosis. The latter is by far the most important because more frequently encountered. The second report of the British Royal Commission on Metalliferous Mines and Quarries (1914) quotes experiments of Beattie as follows:

"Certain mineral dusts, such as coal, clay, cement, were not shown by experiment to be injurious. Other dusts, e.g., silica, quartz, flint, sandstone, are injurious, as are also carborundum and emery. After careful consideration, therefore, we feel justified in concluding that, even although further investigation should disclose other dusts as injurious, the dust of fine crystalline silica is especially injurious and is the more potent cause of fibrosis."

The commission was further of the opinion that inorganic dusts may be grouped in two classes:

(1) "Dusts, the inhalation of which has not so far been shown to be associated with any marked increased mortality from respiratory diseases—to this class belong coal, shale, slate, iron ore, clay, limestone, plaster of Paris, and cement." (2) "Dusts, the inhalation of which is associated with excessive mortality from respiratory diseases, and especially from phthisis—to this class belong quartz, quartzite (i.e., ganister and buhr stone), flint and sandstone."

It seems reasonably certain, from the evidence at hand, that hard, gritty dusts composed of sharp and jagged particles are the ones to be especially feared. The least innocuous of the inorganic dusts is soot. In most large cities and especially those containing large manufacturing plants, the air is filled with soot. Klotz (17) in a study of the lungs of individuals long resident in Pittsburgh, Pa., has shown that a mild grade of pneumoconiosis and fibrosis arises from this source.

The evil effects of metallic dust, usually in the form of fine particles of steel or iron, are frequently referred to and are cited by most writers as the most dangerous of all. It is noteworthy, however, that fine iron particles have rarely, if ever, been demonstrated in the substance of the lung. The cases of siderosis reported by Zenker (18) and Merkel (19) were caused by the red oxide of iron used by gold beaters and looking-glass polishers. The first case observed by Zenker was a girl who had inhaled a thick dust of iron for ten or twelve hours a day. Her work was to color blotting paper with a powder of red oxide of iron. Up to 1912, twenty-one cases of pneumoconiosis of this type had been reported (Dieulafoy).

Greenhow (20) in the examination of a grinder's lung, could find no excess of iron, either chemically or by the use of a magnet. In common with a number of other observers he was of the opinion that the pulmonary lesions were to be attributed to an excess of silica from the grindstone. Soper (21) in a chemical analysis of the dust from the New York subway showed that it contained 61.30 per cent. of iron, nearly all of which was in the metallic state; there was also 15.58 per cent. of silica. He points out, however, that it must not be supposed that the aggregate weight of metal which these figures indicate was capable of being mixed with the air which is breathed. Many of these iron particles were visible to the naked eye and too heavy and too large to be carried far or be sustained in the atmosphere, even by the strongest draughts of air.

The *size of the individual particles* plays an important part. The finer the dust the more dangerous, and there is every reason to believe that only the very finest particles obtain a permanent footing in the pulmonary tissue. Collis (1) lays special stress on the fineness of the dust, as in his opinion, it is only the very minute particles which gain access to the lungs. He states that all materials similar in origin and in chemical composition do not give rise to dust of similar fineness, and in this element of difference may lie the explanation of the fact that two otherwise similar dusts may produce dissimilar symptoms.

Several excellent studies have been made on the size of the silica particles found in the lungs. Watkins-Pitchford (22) states that the majority of visible siliceous particles (as detected by means of polarized light), in the sections of silicotic lung vary from 2 μ to 12 μ in maximum diameter. Larger particles seen by him in his investigation were found, not in the lung tissue, but in the cavities of bronchioles or alveoli. John McCrae (23) studied six lungs of miners who had suffered from silicosis. The ash from each lung was carefully dried at a low temperature so that no splintering of the silica particles should take place by excessive heating. A thin emulsion was then made from the powder and examined with the microscope. The great majority of the particles

were found to be of indefinite shape and to have a diameter less than 1 μ (that is, a diameter less than one-eighth of that of a red blood corpuscle); the amount of material with a diameter less than 1 μ was very approximately 70 per cent. of the whole. Of the remaining 30 per cent. the longest diameter varied between 1 μ and 8.5 μ. Only a negligibly small number of particles was seen whose longest diameter exceeded 8.5 μ, and the very longest observed was 10.5 μ.

Watkins-Pitchford (24) found that the prevailing outline of the particles (as shown by polarized light) was narrow and elongated with one or both extremities pointed; many showed a slight curve in their long diameter and some were elliptical; the commonest form was that of a very slender prism, having its ends cut off at a right angle or obliquely.

Concentration of the dust is also an important factor. If the worker is exposed to dust in a closely confined space the effects are more severe and pathological changes are more quickly produced than if the exposure occurs in a well-ventilated room or in the open. The very severe effects produced in the gold miners of South Africa and the zinc miners in southwestern Missouri are largely due to the fact that the rock dust accumulates in underground passages and chambers. In the Rand, holes are bored into the rock, which, if not moistened, emit a constant stream of fine dust which thoroughly impregnates the atmosphere; and, after blasting, sufficient time is not allowed to permit of the dust settling. The finest dust is produced by blasting; over 99.5 per cent. of the particles are below 12 μ in diameter and the average diameter is under 2.5 μ. This dust is produced in enormous quantities, although only over a short space of time. The dust contents of the air after blasting may amount to 500 mg. per cubic meter and contain in that volume nearly 86,000,000,000 particles of a diameter of 12 μ and downwards (25).

The length of exposure is also an important factor. It is rare, for instance, to find the appearance of definite early changes after exposure to siliceous dust with an exposure less than four or five years (Watt and Steuart). In the case of dusts less injurious, even early pulmonary changes may not be detected under ten or even fifteen years of exposure.

Briefly summarized, inorganic dusts, no matter what their source, produce definite changes in the lungs. They differ in the severity of the lesions produced in accordance with hardness, sharpness and chemical composition. At one end of the scale are the siliceous dusts, capable, under favorable conditions, of producing serious pulmonary damage in a comparatively brief period of time. At the other end are those which produce slight changes and then only after years of exposure. Among the latter may be mentioned plaster of Paris, lime, bituminous coal and soft carbonaceous material in the form of soot.

Organic Dust

Whether organic dust is of itself injurious is debatable. Certainly up to the present the evidence in favor of its causing chronic pathological changes in any way comparable to those produced by inorganic dust is not forthcoming.

The inorganic dusts are in part animal and in part vegetable. It is conceivable that a few of them, such as the dust arising from very hard wood, such as ebony or rose wood, may cause damage. And the same may be said of certain of the animal dusts such as ivory, bone, tortoise-shell, and horn. But even these stand very low in the list of injurious dusts and it is questionable whether the dust involved by working these substances is sufficiently fine to cause trouble.

Of the other organic dusts, some vegetable, others animal, which are encountered in the textile manufactures, there is no proof that they cause changes in the lungs. Among these dusts may be mentioned cotton, silk, wool, flax, hemp, hair, tobacco, etc. We have already seen that even the inorganic dusts vary tremendously in their power for mischief and that their injurious properties are largely dependent on hardness and on the angularity of the individual particles. If these properties are lacking the resultant injury to the respiratory tract is slight or even negligible, as in the case of soot or cement dust. Such being the case it is difficult to see how dust which is utterly devoid of these properties can of itself cause injury. As we shall show later, manufacturing processes associated with organic dust have in many instances been given a bad

name because of the high incidence of tuberculosis among the employees. It has been assumed that the dust was responsible. This I disagree with and my reasons for this will be given in another place.

Oliver (26) is of the opinion that dust composed of cotton fibres is *per se* innocuous, and if the moisture necessary in the weaving of cotton could be dispensed with the trade would be harmless. On the other hand Collis (1) states that cotton "strippers" who are exposed to much cotton fibre dust often develop, after some years of exposure, a condition in which the worker experiences asthmatic symptoms and sense of tightness across the chest, but that phthisis is not found to be especially prevalent among those affected. Oliver also is the authority for the statement that he had never seen any ill effects associated with the manufacture of cigars or cigarettes, at least in so far as dust is concerned. The experience of Dr. Miller and myself is in agreement with this.

In this study Drs. Miller and Smith have shown that the dust obtained from places associated with the organic type was never purely organic but a mixed form containing greater or smaller quantities of inorganic material. And even where the inorganic is present in noticeable quantities it is not sufficient to produce changes in the lungs which differ in any particular from those observed in the urban dweller. For instance, the investigation of a carpet manufactory revealed an appalling state of dustiness, and yet in spite of exposure for many years the roentgenologic pictures of the lungs showed changes which differ in no respect from those encountered in individuals who have lived all their lives in a large city.

This is in striking contrast to the changes observed among those exposed to inorganic dust. In these individuals the changes are definite and they show a steady development; so much so that, given the type of dust and the length of exposure, one can hazard a shrewd guess as to pulmonary changes as revealed by the roentgenograph.

If organic dusts are incapable of producing chronic inflammatory changes in the lungs, can they be wholly disregarded? In the light of our present knowledge this would be unwise. We need more and better studies in regard to this type of dust with reference especially to the part it plays as a carrier of bacteria. In order to do this intensive studies are needed. All contributing factors must be eliminated, and this is especially true in regard to tuberculosis. Faulty hygienic conditions in the shop; unsanitary living conditions; malnutrition and insufficient wages must be eliminated as factors.

Recent studies on the etiology of asthma point very clearly to the fact that the disease is, in many instances, apparently an evidence of protein hypersensitiveness. In many instances the evidence seems clear. Among the better known examples are instances in which an asthmatic attack is brought about by exposure to the emanations of animals or the inhalation of dust containing pollen. The condition is analogous to that produced in animals by the injection of a foreign protein and is characterized by spasm and constriction of the finer bronchioles and, to a lesser extent, by swelling of the mucous membrane of the bronchioles.

In several occupations associated with organic dust, acute respiratory symptoms often arise in susceptible individuals which are probably the result of protein poisoning. Oliver (27) states that in the manufacture of shoddy the grinding of the rags by machinery results in the formation of considerable quantities of dust, the inhalation of which is very trying to new hands but which has little or no immediate effects on the older work people. Those persons who are new to the trade develop what is known as "shoddy fever," the symptoms of which are a rise in temperature, severe headache, signs of bronchial catarrh, and running at the nose. The work people shiver as if they were going to have a severe fever and they complain of muscular pains. The condition is sometimes referred to as "mill fever" and has been noted as occurring in cotton operatives and those who work in flock, jute and flax. A similar condition is observed in grain threshers. Workers who are especially susceptible will, in the beginning of the threshing season, develop a headache and great irritation of the respiratory tract. In addition there is considerable depression, a sensation of chilliness and often high fever. After a few days these symptoms pass off and the worker is apparently immunized for the remainder of the sea-

son. The symptoms in this instance are probably due to the inhalation of pollen, especially that of rag-weed. Landis (28) and Bowen (29) have also directed attention to the symptoms arising in threshers. The symptoms, they state, are often severe and alarming. They consist of a chill, vomiting, a flushed face, delirium, and a temperature which may reach 104 F. There is marked congestion of the mucous membrane of the respiratory tract and a copious nasal and bronchial exudate which contains quantities of microscopic dust particles.

In this category may be placed those instances of respiratory infections due to the inhalation of grain dust. While this dust contains much organic material it also undoubtedly contains considerable inorganic matter and is therefore to be regarded as a mixed dust. Formerly when the grain was transferred from vessels and cars to the elevator, and vice versa, the work was done by shoveling. Thomas F. Rochester (30) called attention to the fact that the "scoopers" or "shovelers" were extremely susceptible to acute respiratory disorders. Beginners often developed marked nasal irritation or a bronchitis, subacute in character. After two or three years an unusual type of broncho-pneumonia was of frequent occurrence. Because of the character of the employment it was commonly referred to in Buffalo as "elevator pneumonia." The attack was usually severe and at autopsy the lungs presented an engorged appearance at the bases and occasionally deep blood-red infarctions were found. The bronchial mucous membrane was without exception swollen and thickened. Convalescence in these cases was usually prolonged, being rarely under three months. A change of occupation was usually followed by complete restoration of health. The introduction of machinery for transferring the grain has apparently done away with the trouble.

Ramazzini, in 1670, in writing of the dust exposure in grain handlers, stated that: "The throat, the lungs, and the eyes sustain no small damage by it, for it stuffs and dries up the throat; it lines the pulmonary vessels with a dusty matter that causes a dry and obstinate cough." The acute symptoms in these cases are in all probability to be attributed to protein intoxication. In those who develop the evidences of organic changes in the lungs the condition can, without much doubt, be attributed to the large quantities of inorganic dust which is mixed with the grain.

Occasionally one of the acute infectious diseases is acquired by the inhalation of dust containing the specific organism. Rarely a fulminant and very fatal type of anthrax is encountered in which the disease is localized in the lungs.

The influence exerted by the trade process and the hygienic habits of the worker in his home are dealt with under the heading "The Relationship Between the Dusty Trades and Tuberculosis."

The Relationship Between the Dusty Trades and Tuberculosis

The most serious indictment against the dusty trades is that they cause, or at least predispose to, a high death rate from pulmonary tuberculosis. At first sight the evidence seems conclusive, but on closer analysis it is a question as to whether the facts as presented are altogether acceptable.

In considering the relation between the dusts and tuberculosis it is necessary to consider the inorganic and the organic type separately.

Inorganic Dust

Inorganic dust does produce definite pathological changes in the lungs. Of this there is no question. As has already been pointed out the changes may be very severe as in the case of silica, or they practically may be negligible, as in the case of soot. Because changes are produced by inorganic dust, the majority of writers on the subject assume that these changes render the individual more susceptible to tuberculosis. When we come to study the pathology of pneumoconiosis and tuberculosis, however, it is difficult to accept this view. The essential feature of the changes in pneumoconiosis is the formation of fibroid tissue. The arrest of a tuberculosis process, on the other hand, is brought about by the formation of fibroid tissue which walls off and prevents the spread of the tubercles.

In pulmonary tuberculosis the rapidity or the slowness of the spread of the disease is largely dependent on one factor,

namely, the formation of fibroid tissue. In the acute forms of tuberculosis one of the striking features of the pathological picture is the absence of fibroid tissue. Caseous areas coalesce, break down, and form ragged, ill-defined cavities with apparently no attempt on the part of the cells to limit the spread of the disease. On the other hand, in the slowly progressing form of chronic ulcerative tuberculosis, and especially in the so-called fibroid phthisis, there is always an overgrowth of fibroid tissue. If cavities are present there is a well-defined fibrous wall, and scattered throughout the invaded portion of the lung the evidence of fibroid tissue is plainly apparent.

In the section on "Pathology" reference has been made to the presence, in silicotic lungs, of areas of dense fibrous tissue which sometimes show the presence of tubercle bacilli histologically, or if emulsified and injected into guinea pigs, tuberculosis sometimes develops. This, I take it, is an evidence of extreme resistance on the part of the lung rather than susceptibility to the infection. It has furthermore been pointed out that when tuberculosis develops in the early stage of silicosis that the tuberculous foci hasten the formation of fibrous tissue in their vicinity and that the silicosis or fibrosis in these areas is far in advance of that in other portions of the lung.

Beattie (31), in considering the occurrence of tuberculosis among grinders, feels that dust does its damage only in "reducing the area of effective lung tissue, and probably therefore encouraging the lodgment of tubercle bacilli, but no one who has studied the pathological processes in the lung in cases of tuberculosis can be anything but skeptical when he is told that fibrosis encourages the spread of the tuberculous process."

Under the circumstances it is difficult to understand how a process which, in one case retards the activities of the tubercle bacillus, can under other circumstances render the condition for its spread more favorable. Wainwright and Nichols (32), in their study of anthracosis, expressed the belief that coal miners were less susceptible to tuberculosis than other individuals because of the diffuse fibroid changes in their lungs. That the carbon dust was in any way germicidal they did not believe. Klotz (17) and Smart (33) have expressed the same opinion.

In the older literature on tuberculosis there are not a few references on the value of lime dust in the treatment of tuberculous individuals. In the past decade Fisac (34) has, on several occasions, drawn attention to the immunity against tuberculosis displayed by persons whose occupation brings them into close contact with lime and plaster. It is his belief that each individual soil has its special chemical composition. This chemical composition will decide whether tubercle bacilli can get a foothold and multiply or whether the tissues react with a fibrous growth, checking the proliferation of the germs.

Another stumbling block in the case of inorganic dust is that it leads to changes in the lungs which are not to be distinguished from tuberculosis either by the symptoms or the physical signs; and even the roentgenogram may, at times, be difficult to interpret. My own experience with potters under my care at the White Haven Sanatorium is that a diagnosis of tuberculosis is often made when in reality the individual is suffering from a diffuse fibrosis of the lungs, associated with dilatation of the bronchi. The only certain means of distinguishing between the two conditions is the examination of the sputum. It is not safe to assume that because an individual in a dusty trade has the symptoms and physical signs of pulmonary tuberculosis that he is necessarily tuberculous. The strongest evidence in support of the frequency of tuberculosis due to or associated with inorganic dust are mortality statistics. Unfortunately much of the value of this data is vitiated by careless diagnoses. Far too often a diagnosis of tuberculosis is made without a sputum examination.

Furthermore, I now have knowledge of several potters who became tuberculous, had their disease arrested, and returned to their former work. In each case a number of years have elapsed and the patient has remained well in spite of being exposed to the same conditions as existed prior to his illness.

It is not to be understood that tuberculosis cannot develop in the presence of an existing fibrosis of the lungs. It undoubtedly does. But when it occurs, and this is true of potters, it commonly runs a latent

and more prolonged course than is the case of uncomplicated phthisis.

It has long been recognized that the age period at which potters succumb to tuberculosis is far beyond the average, and in addition the disease seems to be much less severe than the same amount of damage produces in other classes of patients. Most of the available statistics on the subject support this view. Thus the English mortality statistics for the three years ending 1902 (35) state that the mortality of potters, between the ages of 20 and 35 years, falls below that of occupied and retired males generally. At every other period, however, it shows an excess which amounts to no less than 74 per cent. at ages 45 to 55 years, and to 66 per cent. at ages 55 to 65 years. The principal excess falls under the head of respiratory diseases.

The following table (36) shows the proportionate mortality from consumption among potters, compared with that of males in the registration area in the United States:

Age at Death	Deaths of Potters, 1897 to 1905, from		Per Cent of Deaths Due to Tuberculosis Among	
	All Causes	Pulmonary Tuberculosis	Potters	Males in Registration Area, 1900-1905
15 to 24 years	46	11	23.9	27.8
25 to 34 years	68	36	52.9	31.3
35 to 44 years	84	37	44.0	23.6
45 to 54 years	78	22	28.2	15.0
55 to 64 years	72	14	19.4	8.1
65 years or over	36	7	19.4	2.7
Total	384	127	31.3	18.0

My own belief is that the higher incidence of tuberculosis among those exposed to inorganic dust is due to the fact that the dust acts as a convenient carrier of tubercle bacilli. In other words, it is not the preliminary injury which the dust is responsible for that predisposes the individual to tuberculosis, but the readiness with which tubercle bacilli may be carried into the respiratory tract by a dust-laden atmosphere. If an infected worker is careless in spitting on the floor, the sputum becomes dry and mixes with the dust, thus making it easier for the bacilli to reach the lung. Moreover, tubercle bacilli which become mixed with dust are, to a certain extent, protected and not as much exposed to the germicidal action of air and light as are those deposited in places free from dust.

In a survey made of the conditions in the gold mines in the Transvaal, South Africa, Watkins-Pitchford (37) found that 15.2 per cent. of samples of sputa obtained underground, chiefly from shafts and main traveling ways, showed the presence of tubercle bacilli, as against 2.5 per cent. of sputa collected in the living rooms or places of resort of white and native mine workers on the surface. The difference in these figures is probably to be ascribed to the fact that the dark, humid atmosphere of the mine aids in prolonging the life of the bacillus. It was also observed that the tubercle bacillus will survive in acid mine waters for a period of at least two months. If, therefore, a number of tuberculous infected miners are careless in spitting about the working places in the mine, the chance of infecting their fellow-workmen is great. And this danger of infection is quite independent of whether the workers have developed silicosis or not.

Beattie (31) has expressed the belief that the prevalence of tuberculosis among grinders is due to spitting on the wheels and hands, and thus contaminating the water which all use for wet grinding.

In a preliminary inquiry into the prevalence of pulmonary tuberculosis among the native mine workers in the Rand, Watkins-Pitchford, Orenstein and Steuart (38) state that tuberculosis is the main incapacitating factor in silicosis and that if open communicable cases of tuoerculosis are rigidly excluded from the mines, the danger is greatly reduced.

Another factor to be considered is the exposure to infection entirely independ-

ently of the occupation. Tuberculosis has long been recognized as a house disease, for it is here that exposure occurs more often and more intensely than anywhere else. In an intensive study of 743 garment makers made by Reed and myself (39), tuberculosis in other members of the family was encountered in 27, or 6.7 per cent. of 402 males, and 13, or 3.8 per cent. of 341 females. The question of whether the worker is exposed to the disease in the home or has a family history of tuberculosis is extremely important. When such is the case it would be difficult to fasten the blame on the occupation. During the year 1913 there were treated in the Phipps Institute Dispensary 685 cases with a positive diagnosis of tuberculosis, and of this number ninety-six, or 14 per cent. were garment-workers. Twenty-seven, or 28 per cent., of the ninety-six, gave a family history of tuberculosis. Furthermore, the social histories of patients with tuberculosis but following an occupation other than that of garment making, showed that in 108 instances one or more members of the family were employed as garment-makers. It is thus seen that the worker is often exposed to danger of infection in the home.

In the present investigation the family histories of thirty-nine potters showed that the mother or a brother or a sister had died of tuberculosis in six instances (15.4 per cent.). In four more it was stated that the father had died of "potter's asthma," which might or might not have been tuberculosis.

Lanza (40) has emphasized the poor and often wretched conditions under which many of the zinc miners live. Unhygienic living conditions, carelessness of the miners themselves, and overcrowding in small three and four-room shacks are of frequent occurrence. In common with the South African observers, he found little tuberculous infection among the women which could be attributed to the men. Lanza believes, however, that this danger has been underestimated, although the condition may be explainable by reason of the short period during which many cases of miners' consumption emit tubercle bacilli before death. The danger to the children on the other hand is, he believes, a serious one. He concludes that aside from the hygienic supervision of working conditions underground, education of the miner against the spread of infection and supervision of miners' children, especially those of consumptive parents, are matters of vital importance.

In this connection it is interesting to note that in the state of Victoria, Australia, statistics show that while the incidence of tuberculosis is excessive among males in the Bendigo mining district, it is also excessive among the females who are in no way involved in mining operations. A careful study of sixty-five miners showed that 50 per cent. gave a clear history of close contact with cases of tuberculosis (41).

In closing this subject, I would redirect attention to Cornet's (42) original observations on the transmission of tuberculosis, namely, *The Diffusion of Tubercle Bacilli Exterior to the Body* and *The Mortality of the Nursing Orders*. An excellent review of both papers will be found in Tyndall's *New Fragments*, Appleton & Co., 1897. It has seemed to me, and the conviction grows stronger the more I study the problem, that the universal tendency is to emphasize the danger of dust and to minimize the fact that without the tubercle bacillus tuberculosis cannot be produced. Whether intentional or not, one gets the impression in reading of the dangers of dust that it is the dust which produces tuberculosis.

In a few instances conditions simulating pulmonary tuberculosis can be produced by dust, but in the overwhelming majority of cases no such change occurs. In other words we can eliminate dust, at least in the industrial sense, and still be exposed to the danger of tuberculosis if open active cases expectorate freely about the working places. Cornet showed from his study of the Catholic Nursing Orders in Germany that the mortality from tuberculosis was appallingly high and was to be ascribed to the close confinement of the nurses and to carelessness on the part of patients at a time when the danger of tuberculous sputum was but little appreciated. Let us keep before us the fact that some of the inorganic dusts are, *per se*, capable of producing serious pathological changes in the lungs; that others lead to slight changes; and that many of them produce no appreciable alterations whatever. Tuberculosis may be grafted on

such a process, but in such an event the exciting cause is the tubercle bacillus which has been thrown off by a pre-existing case of tuberculosis. In this connection may be quoted a paragraph from the second report of the British Royal Commission on Metalliferous Mines and Quarries (1914): "One conclusion at which we have arrived is that the cause of miners' phthisis is the inhalation of dust of crystalline silica, upon which is superimposed tubercular infection. Moreover, we agree that it is the tubercle bacillus which causes destruction of the lung and that dust is not necessarily dangerous to life." Professor Beattie said "The dust is not nearly as dangerous to life as the tubercle bacillus. If you get rid of the bacillus of tuberculosis the dust is not so bad."

Organic Dust

In the case of organic dust the problem is decidedly different. In the first place we can dismiss at once the question of injury to the respiratory tract as the result of the inhalation of organic material. The only factor in common is the part played by the dust particles as carriers of tubercle bacilli.

There is no doubt that among those who are employed in trades in which there is an exposure to organic dust there is often a high death rate from pulmonary tuberculosis. That organic dust *per se* is responsible, in that it produces pathological changes in the lungs, and thus renders them more susceptible to tuberculous infection, cannot be demonstrated. There is no pathological proof that such is the case and our experience with the X-rays is distinctly adverse to such an opinion.

In the case of inorganic dust the proof is indubitable and if undue exposure to this type of dust occurs, pathological changes are seen to result no matter what the habits or circumstances of the individual may be. Among those exposed to organic dust there are a number of factors to be considered in determining the high incidence of tuberculosis in this class of workers.

In the first place a large proportion of workers exposed to inorganic dust such as potters, miners, metal workers, are skilled and highly paid artisans while those employed as cotton mill operators, textile workers, etc., are, for the most part, unskilled and poorly paid. The relationship which exists between wages and ill-health is one of the most debated questions of the day. To what extent higher wages would do away with disease is problematical but there can be no doubt that a low wage often compels the worker to live in localities, the sanitary conditions of which are often poor. Furthermore, he is only too frequently undernourished, either because of an inferior quality of food or insufficient food. In this connection, however, it is only fair to state that the undernourished condition of many of the laboring class is to be ascribed to ignorance as to food values. In an intensive study made of the dietary of dispensary patients, many of them employed in the textile trades, Craig and I (43), found that they were getting only about four-fifths the quantity of food they should. This was due in part to an inadequate wage and in part to ignorance of food values. Formerly the working environment was often unsanitary, but in recent years tremendous strides have been made in the direction of improving these conditions.

In nearly all of the occupations in which the worker is exposed to organic dust it is well to remember that in the badly ventilated state of one factory compared with another, the home life and surroundings of the work people, poverty, heredity, age and sex are to be found conditions that favor the production of ill-health, and are therefore not to be ignored. This can best be illustrated by a few concrete instances. It is well known that the mortality from tuberculosis among tobacco workers is excessively high. This trade is usually listed as one of the dusty trades. Two years ago there were admitted to the White Haven Sanatorium, White Haven, Pa., a number of patients from one of the counties in an adjoining state. Among this number were ten young women who gave as their occupation that of cigar maker. All were suffering from a moderately advanced stage of tuberculosis. These women were foreign born, mentally stupid, untidy and of the type that made it reasonably certain that their living conditions were far from being good. They all came from a group of small manufacturing towns closely adjoining each other. These towns are built on a marsh, the

streets are, as a rule, unpaved, underdrainage is lacking, and as a personal inspection showed, the living conditions were vile. There was but one visiting nurse, and she informed me that the enforcement of cleanliness among these people was almost impossible. In addition to their ignorance of hygiene a low wage forced them into the meanest quarters and in addition rendered an adequate diet impossible. That is one side of the picture.

The other side consists of the cigar factory in which these women were employed. It was modern, well lighted, well ventilated and the reverse of being overcrowded by workers. As I had never personally inspected a cigar factory I accepted the dictum that this trade was a dusty one. There was little dust of any kind and so far as tobacco dust is concerned there was none at all for the following reason. In as much as the tobacco leaves are very fragile and must be handled and manipulated constantly in manufacturing the cigar, it is apparent that this can be done only by keeping them moist and pliable. How quickly a dried out cigar can be crumbled into dust is familiar to all. Tobacco dust is absent from this industry, therefore, because of economic reasons.

Dr. E. H. Funk who inspected several large cigar factories for me noted the absence of tobacco dust. Smith and Miller (44), in a hygienic survey of forty-eight cigar manufacturing establishments in Philadelphia concluded that cigar making is not necessarily a dangerous industry. Certainly so far as tobacco dust is concerned it is not. In common with many other manufacturing plants, many cigar making establishments contain varying amounts of mixed dust which is carried in on the shoes of the workers or sifts in through the windows. This is often allowed to accumulate for months at a time. Among the cigar makers whom we studied roentgenologically, none of them showed changes in the lungs which differed in any way from those of the city dweller and in some instances they had followed the trade for twenty-five years or more.

Another fallacy regarding the possible effect that dust may have on ill-health is the failure of our statistics to separate the various occupations into trade processes.

A man employed in a felt hat factory, for instance, will almost invariably designate his employment as a "hatter." It is to be borne in mind, however, that there is a wide difference in the character of the different processes concerned in the manufacture of a hat. Those handling the raw fur which composes the felt may, if exhausts are not employed, be exposed to dust. On the other hand, those who mold the felt into form are as far removed from dust as possible as they work in a steam saturated atmosphere. While this industry is often included among the dusty trades it is noteworthy that of the hatters we have seen at the Phipps Institute, all have been from the molding department. If tuberculosis is unduly prevalent among the workers in this process it is to be ascribed to catarrhal changes induced by exposure to sudden changes in the temperature and to the dampness. Dust certainly plays a very small part.

The cause and effect in the case of inorganic dust is direct and apparent. In the case of organic dust, however, there are a number of contributing factors to be considered and unless we have a complete picture of the worker's life it is unsafe to ascribe all the ills to which the worker may be heir, to the nature of his occupation.

This was well brought out in an intensive study of 743 garment workers made by Reed and myself (39). In this study it was shown that among those workers who took their meals irregularly or who had insufficient or inadequate food and among those who did not get sufficient sleep the incidence of tuberculosis was much higher than in the case of those leading a regular life and obtaining sufficient nourishment. Among the women who were getting insufficient food and sleep the incidence of tuberculosis was three times that of those of whom the reverse was true.

As in the case of inorganic dust, the undue incidence of tuberculosis in association with organic dust is to be explained by the presence of infected individuals who are careless in expectorating on the floors of workrooms and thus permitting the tubercle bacilli to become mixed with the dust.

PATHOLOGY

Inorganic Dust

Before taking up the successive changes which are produced by the inhalation of dust, attention should be directed to the fact that the air passages are provided with a natural defensive mechanism against the entrance of foreign material. The average amount of air which a healthy grown person takes in at each breath has been estimated to be about one-half a litre (about 30 cubic inches). Now there is being little air breathed by the great mass of people, and especially by city dwellers, which does not contain particles of dust and bacteria of various sorts. In an analysis of the outdoor air from various parts of New York City, Prudden (45), found that the average number of bacteria in 10 litres to be 376, and of moulds six.

In buildings and in private houses the number of dust particles and bacteria is greatly reduced. It has long been recognized that the solid particles which we breathe in with the air either through the nose or mouth do not come out with the expired air but are retained on the moist surface upon which the air impinges, going in and coming out. Straus in one experiment found that the expired air contained only forty bacteria, whereas the inspired air held over twenty thousand. Not only bacteria but dust particles are caught largely in the nose, or mouth or upper pharynx. The nose especially is a very efficient dust filter and many dust particles are held on the moist surface of its mucous membrane. When the air current leaves the nose it turns downwards and impinges against the posterior wall of the pharynx. Much of the dust is arrested at this point. The mouth is not so well adapted as the nose for moistening the air and removing the dust particles and bacteria. For this reason those who suffer from nasal obstruction or who breath through the mouth from other causes are more susceptible to "colds" than those who breathe through the nose. A very considerable proportion of the dust in the inbreathed air is spat out, swallowed or removed from the nose.

According to the experience of Watt, Irvine, Johnson and Steuart (25), silicosis is more apt to develop in a mouth breather than in a nose breather. In our own investigation we were at a loss to explain the variations noted in those exposed to the same kind of dust and for an equal length of time. This difference in resistance of individuals to dust was also noted by Arlidge (46), many years ago. Some workers will show in their lungs marked pathological changes while others will show very little evidence of damage, although the circumstances are identical in both. Thinking that variations in the upper respiratory tract might explain the matter, Dr. George Fetterolf, at our request, examined the nose and throat of a number of cement workers. He was unable to find anything, however, which threw any light on the matter. There can be no doubt, however, that the mechanical defense in the nose is superior to that of the mouth and that mouth breathers are therefore more susceptible. On the other hand, there seems to be no doubt that individuals vary almost as much in their reaction to inert dust particles as they do to bacteria. For instance, a potter whom we have had under observation was exposed to clay and flint dust for nearly forty years and yet his lungs showed but a moderate grade of pneumoconiosis. On the other hand, many of his fellow workmen equally exposed and in some instances less so, showed extreme fibroid changes.

Let us return, however, to the dust particles. The floating material which is carried past the upper defenses enters the trachea and bronchi and lodges in their moist walls. Nowhere in the body has nature provided a more ingenuous arrangement for expelling unwelcome intruders. Completely lining the larger air tubes like a mosaic, are myriads of tiny cells shaped something like a narrow short club and set upon end side by side. Projecting from the free ends of each one of these cells is a number of minute hairs. These cells are called cilia. "These myriads of cilia, year in and year out, day and night, while life lasts, are constantly swinging their free ends back and forth, bending as they recover, and then with a quick snap forward so that any small object which lodges on the walls of the larger air tubes—since all the cilia act in rhythm —is swept upwards toward the mouth, away from the perilously delicate and

sensitive lungs." (Prudden).

By the action of the cilia the bulk of the dust particles is arrested and removed under ordinary conditions.

The particles which escape the cilia and penetrate deeper into the respiratory tract encounter another defensive force, namely, the phagocytes and the large cells lining the alveoli. These alveolar cells have been termed the normal "respiratory scavengers." Some of the dust particles are taken up and retained by the large cells lining the alveoli; others are seized by the phagocytes. In the case of bacteria the phagocytes destroy them by absorbing and digesting them. In the case of inert dust particles they are either expelled in the secretions or carried to some point where they will do the least damage. But even these fail to deal with all the dust particles and when overwhelmed as in great exposure, the particles penetrate the mucosa and reach the lymph spaces.

The last defense is the lymphatic system of the lungs and pleura. The lymphatic system of the lungs consists of a series of irregular, narrow channels which open into larger and still larger trunks. The terminus of this system is formed by the bronchial lymph nodes. An interesting observation regarding the direction of the lymph flow in the lungs has been made by Dunham (47). By means of large serial sections he has shown the presence, in the lymph vessels, of valves pointing definitely toward the pleura. These lymphatic vessels have their origin in some instances, in the interalveolar spaces and accompany the large vascular trunks and the bronchi toward the root of the lung; in other instances, they originate in the sub-pleural spaces and communicate on one side with the pleural cavity and on the other anastomose with the lobular and interlobular lymphatics. Many dust particles are taken up by these vessels and deposited in the lymphatic filters, the lymph nodes.

In spite of these defenses, however, there accumulates in the pulmonary tissues a considerable amount of foreign material. The amount will depend almost entirely on the degree of exposure. In all urban dwellers who reach adult life there is some evidence of dust accumulation in the lungs. At birth the lungs are of a pink color but as time goes on and the dust particles gradually accumulate, principally in the form of carbonaceous material, the lungs assume the familiar greyish color seen at the autopsy table. Pneumoconiosis of this degree produces but slight organic changes and rarely interferes with health.

While all forms of inorganic dust bring about essentially the same change in the respiratory tract, they vary one from another, in the extent of the lesions produced and the severity of the symptoms. The sharper and more angular the dust particles, the greater will be the amount of mechanical injury and hence the greater the inflammatory reaction. The most dangerous of the inorganic dusts is the siliceous.

If exposure to the dust is sufficiently long there develops a pharyngitis and later a bronchitis. Between simple irritation as the result of brief exposure, and extensive tissue changes, as the result of prolonged exposure, varying degrees of pathological alteration may occur. It is noteworthy that the changes are very slow in their evolution and except under extraordinary circumstances, it takes years to bring about serious damage.

In the case of a worker exposed to unusual quantities of inorganic dust the majority of the particles are, for a varying length of time, arrested by the moist surface of the mucous membrane, by the action of the ciliated epithelium and by the phagocytes. Sooner or later, however, these defensive forces weaken and finally the dust passes into the lymph channels and also along the finer bronchi until it reaches the parenchyma of the lungs. As a foreign substance it then sets up a chronic inflammatory process.

Our experience is in agreement with that of Arlidge (48) and Watt, Irvine, Johnson and Steuart (25) in that the anterior and inferior marginal portions of the lungs, where expansion is most free, are always less affected than the posterior and apical portions. Radiographic evidence shows also that the change is frequently slightly more advanced in the right lung than in the left.

The microscopic changes which occur in pneumoconiosis have been described by Wainwright and Nichols (32), Haythorn (49), Klotz (17), and by Watt, Irvine, Johnson and Steuart (25). The

evolution of pneumoconiosis is characterized by several well defined stages:

(1) The very earliest changes have been well described by Wainwright and Nichols who, because of accidental deaths, were able to study the lungs of men who had worked in a coal mine but a few months. In these cases they found that some of the epithelial cells lining the alveoli had become swollen and contained particles of coal dust. Sometimes a few larger desquamated cells containing much pigment are found in the alveoli lying loose with some detritus and free dust particles. Even in this early stage, dust particles are seen in the walls of the air vesicles and around the small bronchi. In this stage there is no evidence of connective tissue proliferation. In the case of silicosis, however, it is likely that fibrosis begins at an earlier period than is the case in anthracosis owing to the more irritating properties of the silicious dust.

(2) In this stage it is evident that the dust particles have penetrated all of the first defenses and have gained entrance to the lymphatic channels. The swollen cells containing dust particles are much more numerous and in addition there are present large mononuclear phagocytes filled with dust particles. They lodge first mainly in the small aggregations of lymphoid tissue which lie between the alveoli and along the course of the perivascular, peribronchial and interlobular lymphatics. In a microscopic study of seven silicotic lungs, Watkins-Pitchford (24) was able to demonstrate the situation, outline and dimensions of the mineral particles by means of polarized light. Watt, Irvine, Johnson and Steuart (25) describe the stage as one of *discrete fine fibrosis* which results from the aggregation of dust particles along the course of the small blood vessels and bronchioles and to a limited extent in the interalveolar, interlobular, and sub-pleural tissues. The fibrosis at this stage is almost entirely perivascular and peribronchial. The alveolar walls generally are not thickened and the alveoli are not reduced in size, although they show a certain amount of catarrh.

(3) In this stage the accumulations of dust particles gradually increase. The early perivascular and peribronchial fibrosis becomes more accentuated and in the interalveolar, interlobar and sub-pleural tissues become thickened. In addition nodular collections appear at the points of junction of the various lymph channels where small receptaculi are formed. These nodules become so prominent that they are readily felt by the finger and at times the course of the lymph channel can be detected by the sensation of touch. At the points where the dust collects the fibrous tissue is arranged in concentric layers, and toward the periphery the dust particles are especially numerous. The fibrous masses are well seen in the septa that run in from the pleura. In places considerable sized black triangles with their bases on the pleura are seen, showing where the septum has been completely filled up with dust. The striking point in the whole picture is the extensive plugging and obliteration of the small and medium-sized lymphatics and the compression of the large ones. In the pleura and the peribronchial lymph nodes the picture is a similar one (Haythorn). In this stage the bronchial and mediastinal lymph nodes become enlarged. By some, the plugging of the lymphatic vessels is considered as predisposing the individual to lobar pneumonia. Klotz leans to this view as the result of his studies. Although pneumonia prevails to a considerable extent among the "blacks" in the Rand mines, those who have studied the subject state that silicosis seems to exert little influence. The new arrivals seem especially prone to develop pneumonia but after a residence of six months the incidence of this disease is no greater among the black than among the white miners.

(4) The final and advanced stage is characterized by a general nodular dissemination throughout both lungs. In many places the nodules coalesce forming large fibrous areas. These advanced changes take place as a rule only after years of exposure.

(5) A most important change, from the view point of prevention, was noted by Wainwright and Nichols. They found that in the case of individuals who had formerly been coal miners, but who for many years had not followed that occupation, the lungs no longer showed signs of irritation. The swollen epithelium had subsided and again become normal, and neither the cells nor the alveoli contained

dust. The deposits of dust in the alveolar walls, the septa and peribronchial tissue, however, still remained, as did also the connective tissue thickening.

The changes described above as occurring in man have also been produced in animals. Beattie in an experimental study with guinea pigs drew the following conclusions:

(1) That the effects produced in the lungs of guinea pigs which have been exposed to the inhalation of dust correspond with those produced in man. (2) That the effects produced vary with the length of exposure and particularly with the quantity and quality of the dust which is inhaled. (3) The more concentrated the dust in the atmosphere the more rapidly will fibrosis be produced and the more irritating the dust the more intense will be the fibrosis. (4) The inhalation of such stone dusts as are rich in silica seems to be particularly injurious, and (5) that the powdered shale used in these experiments does not produce more irritation in the lungs than does coal dust, and judging by the comparatively non-injurious effects of coal dust and the general health of the workers, powdered shale may also be regarded as comparatively harmless.

In a study of the lungs of rats exposed to dust in gold mines in the Rand, Johnson (25) states that the development of silicosis in these animals very closely resembles that which occurs in man. The condition is definitely progressive and can be subdivided into stages similar to those noted in miners.

Gross Anatomy

The color of the lung which contains dust pigment will vary according to the extent of the pneumoconiosis and the character of the dust. It may be of varying shades of gray, intensely black (anthracosis) or it may be red, as in the cases of siderosis due to the red oxide of iron reported by Zenker. The slate gray color of the lungs of the city dweller is familiar to all. This constitutes the early change in pneumoconiosis. In the absence of any other lesion such lungs are regarded as normal. Even in the stage of discrete fine fibrosis the lung shows no gross change although occasionally "precocious" macroscopic nodules are noted and the smaller vessels and bronchioles may be slightly raised above the cut surface and definitely palpable.

When the fibrosis reaches a more advanced stage the mottling on the surface of the lung is quite distinct and the interlobular septa are readily distinguished. Occasionally the surface of the lung is scarred and distorted. On palpating such a lung it is aerated throughout but is distinctly less elastic than normal. The walls of the small blood vessels and bronchi are seen to be thickened and they stand out distinctly on the cut surface. Pigmented areas are also seen and it is common to find a number of small microscopic fibrous nodules under the pleura or in the substance of the lung. The bronchial lymph nodes are fibroid and deeply pigmented.

In the advanced stage the lung is hard and more or less solid as the result of fibrosis and is always heavier than normal. In a series of silicotic lungs Watkins-Pitchford (50) found that they weighed from two to three times that of the normal organ. This is due to some extent to the increase in the amount of fibrous tissue but largely to the deposition of dust. In those exposed to siliceous dust Kussmaul (51), found that after incinerating the lung the residual ash might constitute 40 or 50 per cent. of the total. Arlidge (52), in an analysis of the ash from a potter's lung found it contained 47.78 per cent. of silica.

The dominant feature is the fibrosis. The organ often cuts with some difficulty and gives a creaking sound owing to the presence of fibrous nodules. Grittiness, which is so often alluded to, is, in the experience of Watkins-Pitchford * rarely present even in an advanced stage of silicosis. The cut surface feels rough and gritty, partly as a result of the thickened vessels and bronchi, and partly as the result of the deposit of mineral material. Massive fibrous areas may be seen. In some instances they are due to the coalescence of smaller areas, in others they are due to a chronic tuberculous invasion of the lung. In many instances the latter show no gross evidence of tuberculosis, but careful histological studies will often show a few tubercle bacilli and emulsions made from this tissue, if injected into a guinea pig, will often produce tuberculosis. Clinically it is quite likely that such lesions are so latent that they are innocuous. In cases of silicosis more than in any other form of pneumoconiosis the acute forms of tuberculosis, acute pneumonic phthisis and tuberculous broncho-pneumonia, are apt to develop. It has also been noted that when a tuberculous focus occurs in a silicotic lung it seems to hasten the advance-

ment of the silicosis and that about such an area the condition presents itself as a far advanced stage of silicosis while elsewhere the lung may appear to be only in the first stage of the disease. The dense fibrous areas containing a few tubercle bacilli probably represent a slight tuberculous focus which has been healed.

In advanced stages of pneumoconiosis the pleura is usually adherent to the chest wall, although the extent of the adhesions varies somewhat with the nature of the infecting dust. In anthracosis the adhesions may be very slight while in silicosis they are usually dense, the lung being adherent not only to the chest walls but to portions of the pericardium. In quartz miners Purdy (53) states that a common finding is an old or recent pleurisy; notably in the locality of the fifth and sixth ribs in the axillary region.

The only other condition likely to give rise to such extensive pleural thickening is chronic tuberculosis. In the case of the latter disease the lung is shrunken, ragged and collapsed which is in marked contrast to the full, firm and much weightier lung seen in pneumoconiosis.

In common with all forms of pulmonary fibrosis no matter what the exciting cause, dilatation of the bronchi is a common finding in the advanced stages of pneumoconiosis. Calvert Holland (1843) was the first to direct attention to this condition. The dilated bronchi are to be found, as a rule, in the portions of the lung which are most markedly fibroid, namely, about the roots and at the apices.

In common with other forms of chronic inflammation of the bronchi the walls may be thickened and hard. The mucous membrane may be of a dull red tint, or brownish in color, the discoloration being evenly distributed or occurring in patches. The membrane may be thickened in some places and in others thinner than normal. Very often the fine capillary vessels present a varicose appearance.

Emphysema located along the anterior margin and at the bases of the lungs is of frequent occurrence. Emphysema may be noted also between the areas of fibrous tissue.

Cavity formation, the result of tissue necrosis is not common in uncomplicated pneumoconiosis, although it does occasionally occur. Among zinc miners Lanza (40) states that necrosis as the result of pyogenic infection is not infrequent. This manifests itself clinically by the breaking down of the lung tissue and the expectoration of characteristic slaty blue sputum. Abscess formation in the lungs has also been noted among zinc miners. When a cavity is present it is to be regarded as being tuberculous in character until proved otherwise.

A not infrequent finding in anthracotic lungs is a pseudo-cavity due to a saccular dilatation of a bronchus. It is frequently located at the apex, and is readily distinguished as being of bronchial origin by the smooth wall which is continuous with that of the bronchus. Clinically it is important to keep in mind the fact that the bronchi are often dilated in the apical portion of the lung as the physical signs are not to be distinguished from those obtained in the case of a true cavity.

The diaphragm shows most interesting changes. In advanced cases it is nearly always distorted and its functional capacity greatly reduced. As fibrous changes first occur at the root of the lung and often extend downward, the phreno-pericardial angle is often obliterated comparatively early in the disease. This causes a restriction of the inner half of the leaflet usually most marked on the right side. In the advanced stage a sharp angulation of one or both leaflets is often seen, especially on inspiration. In many of these cases it is easy to demonstrate the presence of a fibrous strand extending from the hilus of the lung to the diaphragm at the angular point. This evidently anchors the diaphragm at this point and causes the leaflet to become peaked or angular on inspiration.

If the fibrosis is more decided on one side than on the other, the most affected side will show a greater amount of retraction and the heart will be displaced or drawn toward that side. In as much as pneumoconiosis generally produces a more or less uniform bilateral fibrosis, displacement of the heart is not a marked feature. In the terminal stages dilatation of the right heart is commonly present. It is caused by the obstruction in the pulmonary circulation as the result of the fibroid changes which have occurred in the lung.

Organic Dust: Morbid Anatomy

Although cotton fibers have been demonstrated frequently in the sputum of operatives in cotton mills the invasion of the lung by the material has not yet been shown. And this holds true for all forms of vegetable and animal fibre with the possible exception of particles of dust obtained from the abnormally hard woods.

References in the literature to pathological studies of the lungs of those who have been engaged in trades which have been associated with much dust of animal or vegetable source, are not of frequent occurrence. Or perhaps it would be more accurate to state that such studies rarely have been made with reference to the effects such dusts might have on the lungs. There can be no doubt that the lungs of such individuals have been studied but it is significant that but few references have been made to changes which are analogous to those encountered in the lungs of those exposed to inorganic dust.

Greenhow (20) for instance, studied several lungs obtained from flax dressers. These lungs grossly presented much the same appearance as those seen in potters or others engaged in work which causes exposure to inorganic dust. On incinerating them, however, it was found that the resulting ash was partially dissolved in boiling hydrochloric acid; the part left was dissolved by hydrofluoric acid, thus proving it to be silica.

Hirt (54), states that in two cases where the lungs of horse hair workers were indurated precisely like those of sandstone workers, he could find no trace of horse hair, and therefore concludes that the effect was probably due to the inorganic constituents of the dust.

In considering the effects of inorganic dust all the evidence points to the fact that even this type varies greatly in accordance with the size, hardness and regularity of the dust particles. In as much as all the vegetable and animal dusts with but few exceptions, are devoid of these characteristics it is difficult to understand how they could cause injury. When pathological changes are encountered in the lungs of those who have been exposed to organic dust the lesions are to be ascribed to inorganic material—in other words, it is a mixed dust.

Finally, it might be said that the roentgen rays reveal indubitable evidences of chronic pathological changes in the lungs of those exposed to inorganic dust; that these changes are definitely progressive and develop in a fixed sequence. On the other hand no such changes have been noted in the lungs of those exposed to organic material even when the exposure has been as long as thirty years.

SYMPTOMS

Inorganic Dust

Pathological changes due to an inert substance, such as inorganic dust, differ from those of bacterial origin in that they are slowly but definitely progressive so long as the exposure to the dust continues. Unlike the changes caused by bacteria there are no periods of quiescence and recrudescence. Furthermore, the changes are progressive only so long as the irritant is constantly operative; when the individual is no longer exposed the lesions become non-progressive, although those already present persist throughout life.

Exposure to any form of dust, even for a brief period of time, is apt to cause considerable irritation of the upper air passages, as manifested by a tickling sensation in the throat, cough and sometimes sneezing. After the worker becomes accustomed to the dust he may have no evidence of respiratory irritation for years. In other words, during the first stage of pneumoconiosis there may be no symptoms or only those indicative of a pharyngitis. Even in the early stages of the resulting fibrosis, symptoms may be slight or entirely wanting. This long period of latency is not to be wondered at in a condition whose pathological beginnings are fine and generalized. The symptoms will naturally be correspondingly insidious and their onset more elusive in character than is the case with most other pulmonary diseases. To this latency, in spite of definitely progressive lesions, is to be ascribed the difficulty of recognizing the condition by ordinary clinical methods. That the fibrosis is the principal cause of the respiratory symptoms there seems to be no doubt.

The more the effects of inorganic dust are studied the more apparent it becomes that silica is by far the most injurious

form encountered. When the worker is subjected to this type of dust in great concentration the fibroid changes in the lungs develop relatively quickly and evidences of respiratory damage are correspondingly early in their appearance. The evil effects of silicious dust have been well shown among the gold miners in South Africa and by Lanza (40) among the zinc miners in southwestern Missouri. In both instances the dust is almost entirely silicious in nature and, by reason of the work being done in closely confined underground chambers, the concentration is great. Under these circumstances early pulmonary changes may be noted in four or five years.

Even in the case of dusts which are not purely silicious the amount of damage seems to be proportionate to the amount of silica they contain. If silica is absent or exists in small amounts only, the evolution of the process is very slow and years may elapse without there being any appreciable damage. Thus among sixteen cement workers studied in the present investigation only one had a cough. The remainder were entirely free from respiratory symptoms. While the average length of time these men had been in the industry was comparatively short (average 10 years) the dust exposure was most intense. Among potters whom I have studied (55), serious symptoms rarely arose until the worker had been in the trade from ten to twenty years. In the present study freedom from any respiratory symptoms was noted after 38, 41, 49, 51, and 54 years of employment among thirty-nine potters. On the other hand, one man after six years in the trade had had an irritating cough for over a year.

The progress of the disease is, therefore, commonly slow but when induration of the pulmonary tissues has once been established, it tends to advance more rapidly, though insidiously. As a rule, *cough*, often unproductive in character, is the first symptom, especially in the milder types of pneumoconiosis. This is usually worse in the morning, is often paroxysmal, and tends to become increasingly severe. Following the morning paroxysm of coughing the worker frequently vomits. That eating seems to play some part in the vomiting is apparent by reason of the fact that the omission of breakfast minimizes or abolishes the paroxysm. By some the coughing paroxysm is ascribed to irritation of the gastro-intestinal tract as the result of the ingestion of the dust. Occasionally the cough may be wanting entirely. In the great majority of cases the dry, hacking cough is sooner or later associated with *sputum*. The expectorated matter at first is small in amount, tenacious and greyish in color as the result of small specks of carbonaceous matter. Even when the dust is not black in color, as in the case of clay or flint dust, the expectorated matter is usually greyish in color. In coal miners the expectorated matter is often inky black in color, hence the name "black-spit," sometimes applied to anthracosis. If the dust is composed of some distinctive coloring matter, such as red oxide or iron or ultra-marine blue, the sputum maybe either red or blue in color. Lanza (40) states that among zinc miners the sputum is often very characteristic, in fact diagnostic, being of a marked slaty blue color and of a very tenacious consistency. In doubtful cases sputum of this character is sufficient to determine a diagnosis. The color is due to the inhalation of dust which has become imbedded in the tissues. In this case the dust is composed of powdered chert which is an impure flinty rock, including the jaspers. In the stage of extreme fibrosis the sputum often becomes mucopurulent and is frequently blood streaked. Small *hemoptyses* are not uncommon. Of 433 cases of silicosis studied by Lanza (40), 33 per cent. of those in the first stage had hemorrhages; in the second stage, 10.5 per cent.; in the third stage, 20.5 per cent. of the uncomplicated cases and 30 per cent. of those with an added tuberculous infection. Night sweats are uncommon.

If there is an associated *bronchiectasis* located in the inferior portions of the lungs the sputum may be profuse and fetid in character. Dilatation of the bronchi at the apices, on the other hand, is not associated with excessive expectoration or fetor of the sputum as the drainage is good and stagnation of the bronchial secretions does not occur. In common with other individuals subject to chronic pulmonary lesions these patients are frequent sufferers from acute colds, and during such attacks the amount of sputum is markedly increased.

Shortness of breath on exertion or a more or less constant dyspnea sooner or later makes its appearance. In the case of true silicosis, dyspnea usually antedates the appearance of a cough and for a varying period of time may be the only symptom complained of. It is often more annoying than the cough and although in the milder cases it may be noticeable only on slight exertion, it is felt in the severer forms even when the patient is at rest. At times it has some resemblance to asthma, the breathing being wheezy in character. In such cases the inhalation of the dust seems to be the exciting factor. In a potter whom we had under observation the "asthmatic" symptoms entirely disappeared when he gave up the trade after being in it over forty years. The shortness of breath has been ascribed partly to the associated emphysema and partly to the replacement of pulmonary tissue by the fibrosis. A most important factor, in our opinion, is the functional capacity of the diaphragm. We found that in those cases in which both leaflets of the diaphragm were freely movable, shortness of breath was absent. This was so constantly the case that accordingly as the patient gave a history of being free from dyspnea or one indicating this symptom, we could predict the fluoroscopic findings in regard to the diaphragm. Those who have studied the effects of silica in the lungs of gold miners in South Africa state that shortness of breath on exertion is one of the earliest of the cardinal symptoms and is to be ascribed to the loss of pulmonary elasticity, as evidenced by diminished chest expansion (56).

As the disease advances a feeling of tightness and constriction of the chest is often present and in addition definite *pleuritic pain* may be complained of. In silicosis chest pain is often an early symptom and one that persists throughout the course of the disease although it may remit in the terminal stage. The location of the pain is variable but it is worth remembering that the pain or sense of tightness in the chest is often referred to the upper parts of the thorax—that is, in that portion where the early changes of pneumoconiosis first make their appearance.

The *general appearance* of the worker whose lungs show an early fibrosis is that of robust health. As the condition progresses, however, some impairment of the health may manifest itself. The individual reaction to the condition is, however, extremely variable. Some will show no appreciable deterioration in health in spite of marked fibroid changes, while others will begin to lose flesh, become anemic and even in uncomplicated cases, present a picture not unlike that of chronic tuberculosis. In the early stages the blood pressure is normal but as the process advances and the right heart dilates as the result of obstruction in the pulmonary circulation, the pressure is low.

Uncomplicated pneumoconiosis is often *afebrile*, or if fever is present it is very slight. The presence of any considerable amount of fever should arouse the suspicion that the condition is complicated by *tuberculosis*. The behavior of a tuberculous infection engrafted upon pneumoconiosis is subject to some difference of opinion. The teaching on this subject has, for many years, been to the effect that the clinical manifestations of the tuberculous disease were modified. This has certainly been my experience in the case of potters. Such patients do not look tuberculous; are afebrile, except in the terminal stage; and even then the temperature fluctuations are often not marked. South African observers, however, express the belief that with the occurrence of a tuberculous infection in those suffering from silicosis, the symptoms and signs are predominantly those of the former disease. Lanza, whose investigation was concerned with the same type of dust, namely silica, states that "even when tubercle bacilli are present in the sputum the lack of resemblance is plain and persists until the last few days' of life, when the patient being practically moribund, the resemblance to tuberculosis is more apparent."

It is to be borne in mind that the tuberculous infection, whether previously quiescent or due to a reinfection, is secondary in producing disability, though it may hasten death. While there are cases in which the tuberculous infection seems to exert but little influence on the general health of the patient, its tendency is to aggravate the symptoms and to cause a rapid decline in health. It is to be regarded in the majority of instances as a terminal infection.

Organic Dust

The inhalation of pure organic dust may temporarily cause some irritation of the upper respiratory tract and thus bring about coughing or sneezing or, if a foreign protein is inhaled, an asthmatic seizure may be induced. Other than these there are no symptoms as the type of dust is incapable, with rare exceptions, of causing structural changes in the lungs. The effects of organic dust have been fully discussed in the section on *etiology*.

PHYSICAL SIGNS

Inorganic Dust

In the great majority of cases nothing abnormal is to be detected in the so-called first or second stages of pneumoconiosis. This will be the case when the X-ray shows distinct evidences of changes, particularly in the second stage. Given the type of dust and the length of exposure one can hazard a shrewd guess as to the stage of the disease. When the disease enters the third stage, the physical signs are marked but not distinctive of the condition.

The physical findings in the third stage are as follows:

Inspection.—Expansion of the chest is usually deficient and may be more marked on one side than the other. There may be considerable retraction of one side of the chest and where this is present the heart will be drawn toward that side. Occasionally the chest is somewhat emphysematous in type. Clubbing of the fingers is commonly present and is indicative of an associated bronchiectasis.

Palpation.—This will aid in determining the degree of expansion on the two sides and the location of the apex beat of the heart.

Percussion.—If emphysema is present the note will be hyper-resonant. In the majority of instances, however, there are areas of dullness overlaying the dense fibrosis. The dullness is apt to be more marked in the mid-portion of the lungs and towards the apices. It may be greater on one side than the other. A tympanitic note may be elicited at the apex or near the angle of the scapula. When present it is an indication of bronchiectasis.

Auscultation.—The auscultatory signs are varied. The breath sounds may be diminished in intensity and broncho-vesicular in character. In many cases the breathing is rapid owing to involvement of the diaphragm. If the bronchi are dilated the breathing over the affected area is bronchial or cavernous; this may occur at the apex or near the angle of the scapula. In the latter area one can be almost certain that the signs are due to bronchiectasis while at the apex they may be due to this condition or to a cavity.

Râles of all descriptions may be heard all over both lungs. The condition may be mistaken for chronic bronchitis or owing to the wheezy character of the breathing and the presence of sibilant or sonorous rales, asthma may be suspected.

The voice sounds will vary—they may be suppressed in some areas and exaggerated in others; if the bronchi are dilated, both the spoken and whispered voice are readily transmitted at certain points, namely, the apex or about the angle of the scapula.

The heart shows nothing distinctive. In the advanced stage evidences of dilatation of the right heart may be present.

Organic Dust

As no lesions are produced in the lungs by organic dust physical signs are lacking except in those instances where an asthmatic seizure is induced by the inhalation of a protein containing dust.

X-RAY EXAMINATION

The study of this condition by means of the roentgen rays is the greatest advance which has yet been made. In the past few years several excellent reports of this nature have been published. During the past two years Pancoast, Miller and I (57) have studied a large number of individuals who have been exposed to dusts of various sorts.

In regard to the effects of *organic dust* the subject can be dismissed with the statement that these individuals show no more marked changes than are encountered in those who have dwelt all their lives in large cities. When the evidence of pneumoconiosis is slightly more marked than normal in these cases, it is to be ascribed to the fact that there is a considerable amount of inorganic material mixed with the organic dust. This was notably so in a number of carpet makers we examined.

The roentgenologic picture in the case of those exposed to *inorganic* dust is, in the great majority of cases, characteristic, except perhaps in the very early stage. As a rule, the changes as seen in the roentgenogram correspond closely to the pathological processes.

The first stage is characterized by an increase in the hilus shadows and a thickening of the usually prominent trunk shadows, and an undue prominence of the finer linear markings. It is the rule that the increase in thickness of the bronchial trunk shadows is fairly uniform, which is the main dependence in distinguishing the case from one of peribronchial tuberculosis, but there are exceptions which make the roentgenologic diagnosis difficult or uncertain. The descending trunk shadows seem to be more marked on the right than the left but the interference offered by the heart shadow on the left side may hide a similar condition there. Abnormalities of the diaphragm excursion occur in all stages, even the first. In the first and second stages, however, there is no general rule. The position of the excursion during ordinary respiration between the limits of extreme inspiration and expiration is very variable. The most common finding, in our experience, was a restriction at the inner portion of the right leaflet during full inspiration and either a decided flattening or a concavity of the outer aspect.

The second stage is characterized by a more or less uniformly arranged mottling throughout the lung structure due to the deposition of dust in the lymph spaces, cells and fibrous tissue interspaces, with the addition of a certain amount of localized fibrosis. This stage comprises what has usually been regarded as the typical case of pneumoconiosis. Its onset seems to depend largely upon the character of the dust inhaled. It occurs early in those exposed to silica, comparatively early in coal miners, certain metal grinders and somewhat later in potters and asbestos workers. The distribution of the mottling was found by us to appear invariably first on the right side on a level with the hilus shadow. It certainly becomes quite perceptible on the right side before it appears on the left side and for some time after it does appear on the left side, it is noticeably more marked on the left. In the advanced stage the two sides seem to be about equally involved. The distribution is more or less symmetrical, but naturally not uniform throughout the lung. From the starting point it gradually spreads to the bases and apices, but is never so marked at the extreme apex or base as around the mid-portion of the lung. The appearance of the mottling depends more or less upon the character of the dust. In those exposed to silica the spots are very dense and sharply circumscribed and can be seen when very small. In the case of the less irritating forms of dust the spots are not so sharply defined. The roentgenologic diagnosis in this stage is not difficult. It may be difficult, however, to detect an early tuberculous lesion engrafted upon a well advanced case of pneumoconiosis in the second stage.

The *third stage* is characterized by the appearance of diffuse fibrosis and all that the term implies. While there is no sharp dividing line between the second and third stages, it would appear in some instances that the mottled appearance in the second stage becomes more and more conglomerate and finally passes over into the appearance of dense fibrosis. In other instances a general haze seems to spread over a certain portion of the lung. The greatest density is in the sub-apical regions, although this is not the area of most intense mottling in the second stage. Dense fibrous bands can be seen extending in various directions, and frequently to the diaphragm, causing marked retraction. In this stage the mottling has become extremely coarse and sometimes is to be no longer recognized as such. The heart and blood vessels are frequently dragged out of place and bronchiectatic cavities are quite common.

It is not always easy to differentiate between the fibrosis resulting from tuberculosis and pneumoconiosis and were it not for repeated negative sputum examinations, sometimes extending over a number of years, it would not be easy to say that tuberculosis was not present.

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A CRITICAL REVIEW OF METHODS FOR THE STUDY OF DUST CONTENT OF AIR*

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VARIOUS methods have from time to time been suggested and employed for the study of air dustiness, ranging from mere rough comparative estimations to attempts actually to count the number of floating particles and to weigh the solids in given small samples of air, but until 1916 the number of suggested methods was almost as great as the number of workers interesting themselves in the subject. Early in that year a new method was reported by George T. Palmer (1) of the New York State Commission on Ventilation, and in the next year Dr. E. V. Hill of the Chicago Health Department (2) brought out a new type of dust counter which he demonstrated at a meeting of the American Public Health Association in Washington. Palmer, Coleman and Ward (3) reported a study of three methods with a criticism of fourteen others, comparing results obtained with the Graham-Rogers plate method with the results from the Palmer water spray sampler. The methods referred to but not tested out by them, were Liefmann's oiled plates exposed for definite periods in dusty atmospheres, washed in oil and the washings compared with color standards (6); revolving syrup-covered white paddles (3) read colorimetrically; Aitken's koniscope (7) and his dust counter (8); weighing solids collected from water samples exposed for weeks in the open, as done by the Whipples (9); paper filters washed in oil after exposure to measured air currents and the oil read colorimetrically as done by Rubner (6); cloth filters read colorimetrically after the passage of measured air currents as done by Todd (10); the similar use of collodion wool (Hahn) (6) or resorcin (Winslow and Baskerville) (5) or sugar (Lanza) (11), with subsequent solution of the filtering material and counting of particles; water bubbling as done by Klein for making weight determinations of flue dust (12); weighed cotton wool filters as used by Duckering (13) and Ditman (14); Mariner and Hoskins weighed Soxhlet thimble filters (15) and a modification of Well's centrifugal method of determining bacteria in air as used by the New York Ventilation Commission, with metal bowls substituted for medium-coated tubes (3), but which proved too cumbersome and difficult to operate. They also refer to MacMillan's study of the use of the Cottrell principle (16) of dust precipitation on passage over high tension magnetic poles but give no reference and state no results (3). This last method would be of limited use as the high potential of 40,000 volts would not be readily obtainable, though if a sufficiently compact and portable apparatus were devised containing a transformer, as used experimentally by Cottrell, this method might be adaptable for dust tests. In his early work he used a small transformer to derive a 2000 to 6000 volt current from one of 110 volts and this he found sufficient for experimental work. The apparatus as used by him, however, was not sufficiently portable or compact for general use in dust estimations and there was no way of accurately weighing or otherwise estimating total dust per unit volume of air. Coleman also attempted to use a diffraction device for counting dust suspended in a beam of light and to photograph the luminous particles but obtained no satisfactory results. Dr. Hill reported a series of comparative tests with various methods, found to be more or less unsatisfactory, including cloth screens and vaseline-coated porcelain dishes, as visual comparison or colorimetric tests; muslin filter bags over the inlet of a Sirocco fan, cotton filters connected by a gas meter with a centrifugal fan, and Drechsel wash bottles connected by a meter with an air suction line, as weighing methods: Ait-

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ken's koniscope and dust counter, as condensation methods; a diffractiscope devised by himself; and as counting methods, a sugar filter equipped as was his cotton filter, the Drechsel wash bottles, a moistened photographic plate connected with an anemometer and an exhaust ventilator, and his own specially designed apparatus devised as a result of his studies to overcome the defects of the other methods tried. As the result of the former tests the Committee of Standard Methods for the Examination of Air of the American Public Health Association in their final report presented in 1917 (17), recommended the use of the Palmer apparatus as the method of choice for determining dust in air.

As the papers referred to give rather detailed accounts of most of the various methods tested and discussed, it seems unnecessary for the purposes of this article to go into details of these methods again. They may be divided into several groups, as done by Hill, as follows: (1) Visual Comparison; (2) Weighing Methods; (3) Condensation Methods; (4) Diffraction Methods; (5) Counting Methods.

The majority of the methods suggested fall into one or another of these groups and several collection methods may be used to determine dust in more ways than one, as by visual comparison and by weight with a cloth filter, and by weight and count with a water bubbling method. No one method suggested is suitable for use under all conditions and few have any great range of usefulness. Visual comparison methods are the simplest, but at best give only rough estimates of comparative dustiness under similar conditions with similar types of dust, and are very inaccurate when attempts are made to compare dusts of different size range of particles and of different colors or shades of particles. Various methods of air sampling for the purpose of making color comparisons have been used, such as cloth screen, porcelain dishes, oiled plates, paper or cloth filters and syrup-covered saddles, but none of them give even approximations of the actual amount of solids or of the number of particles in suspension in the air, and they have little or no scientific value.

The simple Canton flannel disc filters as used by Todd (10), through which he aspirated 200 cubic feet of air, should prove very useful, however, for rough, easily made comparisons of relative air cleanliness of school rooms or offices, furnishing permanent records very convincing to the layman and effective arguments for improving conditions. The test is similar in principle to the visible dirt test for milk, which has been of such educational value in milk hygiene work.

Diffraction methods based on the luminosity of floating particles in a beam of light, or as used by Hill (2), on the droplets of moisture condensed on such floating particles when air pressure is lowered in a closed chamber, will show all suspended matter, but here also no size differentiation of particles is possible and even ultra-microscopic particles may be included in the test. As Hill states, this method will determine absolute freedom from dust, but comparative tests are hard to make and no absolute quantitative standards can be arrived at. The size of the apparatus as used by Hill prevents the taking of samples large enough to be representative. The same objection holds to the use of the very ingenious koniscope (7) or the dust counter designed by Dr. Aitken (8), both of which employ the same principle of condensation of moisture on floating particles in a saturated atmosphere, when air pressure is lowered. In the koniscope the degree of dustiness is determined by the denseness of the fog as compared with arbitrary standards, a method subject to considerable variation due to the personal equation; in the dust counter the droplets are allowed to fall on a ruled surface and there counted. All suspended particles will be included here and only extreme size variations can be noted. No idea of the sharpness of mineral particles or of their chemical nature can be obtained from either of Dr. Aitken's apparatus.

Weight determinations with properly controlled methods can be made with the greatest degree of accuracy provided sufficiently large samples can be taken, but of themselves give no clear idea of the number, quality or size of dust particles, all of which are very important factors from the hygienic standpoint. Methods employed for determining weight of dusts include the use of cloth filter bags (2), cotton filters (13), sugar filters (11),

(18), wash bottles (2), precipitation in water in open vessels (9), Soxhlet thimble filters (15) and a modification of the Wells centrifugal method (3), and finally the Palmer apparatus (3). A given weight of lead dust per 100 cubic feet will indicate a much less dusty atmosphere than will the same weight of a vegetable or organic dust, and the number of particles in the same weight of similar dusts will depend, of course, on the size distribution of the particles. Whether the weight of suspended matter in the air or the number and the size of the particles is the most important factor depends on the nature of the dust creating substance, its relative solubility, toxicity or density and shape. With soluble or toxic dusts, the total amount of dust likely to be inhaled, and with non-irritating inorganic dusts, the number of particles, is probably the most important factor; while with sharp spiculate mineral dusts the size, distribution and number should both be important.

The sugar filter has been used in two important investigations on dustiness in mines and has given valuable information. Lanza and Higgins (11) in a study of dust in the hard rock mines of the Joplin District in Missouri collected their samples in sugar filters and determined total weight of dust by filtration of the particles in the dissolved sugar. With large air samples the insoluble matter in the clean sugar is usually too small to influence the results materially, but a blank test should be run on a weighed volume of sugar and corrections made if indicated. Lanza and Higgins filtered the dissolved sugar through a Gouch crucible and determined the weight of the retained solids, and observed the nature of the dust particles by mounting some of the dried residue in cedar oil and examining under the microscope. No attempt was made to count particles or determine size distribution. Their method of collection of the samples was by aspiration into their own lungs through the mouthpiece and tubing of an oxygen rescue helmet, with discharge of expired air into a 35 liter Draeger bag. Breathing into the bag was continued until 35 liters of air had been collected. This is the simplest method employed for measuring larger air samples in dust tests and is the only method where the rate of sampling approaches the normal breathing rate of the worker. For this reason, estimates by this method of the amount of dust inhaled by a worker per diem should be most reliable, provided the tests were run long enough to allow for variations in dust production.

Muir and Johnson (18) in their extended investigation of dust in South African Mines also used a sugar filter for collection. Their work is especially interesting as they were the first to attempt an estimation of the relative amount and number of particles of different sizes. These investigators separated their samples from the dissolved sugar into several different groups, classing all particles under 12 microns in diameter as very fine or injurious, and those from 12 to 50 microns as non-injurious. All particles over 50 microns they discarded as too few in number and too large to be of any sanitary significance after sampling. They dissolved the sugar in water to make a 17 per cent. solution and screened this through a 260 mesh wire gauze, the meshes of which average 50 microns in diameter. The filtrate was then separated by an elutriation process, similar to that used in grading sands for filtration purposes (19), into portions containing the two size groups of particles referred to above. This grouping of particles was based on McCrae's work, a part of the same report. He found, on acid oxidation of the lungs of miners dying from pulmonary or bronchial troubles, that the silicious particles recovered were usually less than 1 or 2 microns in diameter and were never over 12 microns. Muir and Johnson made counts by means of the hemocytometer cell of particles from each size group, and also filtered and ignited the residues and weighed the ash to determine weight of mineral matter, ignoring apparently the organic matter present in the dust. They also reported the advisability of substituting a more hygroscopic substance, such as potassium chloride, for the sugar in very dry atmospheres, and in very humid atmospheres a less hygroscopic substance, as ammonium oxalate, cautioning as to the need of more thorough washing of residues before incineration if this was done. For collection of samples they used, as aspirating force, a compressed air suction pump similar in action

to the commonly used water suction filter pump, aspirating 1 cubic foot per minute until 15 to 100 or more cubic feet of air had been sampled.

The excellent work done by Duckering in the English investigations of the lead risk in the tin plate (20), earthen ware and china (13), (21) industries and in woolen manufacture (22) and his careful control of the amounts sampled show the possibilities of the cotton filter. As used by him in his later tests (21), with a carefully calibrated and frequently tested hand pump as suction force, the method is comparatively simple and it is usable anywhere, regardless of the presence or absence of electricity or water power to supply suction. For soluble or toxic dusts, where the important factor to be determined is the total amount of poisonous substance a worker is likely to inhale per diem, it is a simple and very reliable method; but where insoluble dusts, likely to produce more or less of mechanical irritation or trauma and eventually lead to pulmonary fibrosis, are to be estimated, its findings are not so reliable. It retains all particles, including the large ones not likely to reach the lungs, and gives no reliable figures as to size distribution. The shape of the average particles can be studied, however, and some idea of average size determined by microscopic examination, as is shown by Duckering in his tests on woolen dusts (22). In employing this method care must be exercised to dry the filter bottles thoroughly with a current of warm filtered air before and after each test, and to calibrate and control carefully the force of the pump strokes, as was done by Duckering (21).

Dust counting methods have been in use for some time, but here also the amount of air sampled has usually been small, requiring a very large multiplication factor and a consequent large factor of error. As a preliminary to counting, dust may be collected by filtering air through a soluble medium, such as sugar (11), (18), collodion wool (6) or resorcin (5); by precipitating with droplets of condensed moisture, as in the Aitken apparatus (8); by aspirating through a water spray, as in the Palmer apparatus (3); by bubbling through water (2); or by directing a current of air against an adhesive surface, as in the case of the Graham-Rogers glycerin coated plate (4), Hill's moist photographic negative or the varnished coverglass of his newer apparatus (2).

The amount of air sampled in the Aitken counter is measured in cubic millimeters or fractions thereof, and is too small to be representative. For a representative test in a room with little variations in air currents, a number of tests would be necessary in different parts of the room; and in a room with air currents constantly changing in force and direction, tests would need to be taken at frequent intervals to give any approach to accurate results. With the Aitken apparatus this process would be extremely fatiguing as well as time-consuming. This method is extremely accurate as a means of determining the number of particles in a small volume of air, since an actual count is made, based on the particles in 10 cubic millimeters of air, either undiluted for very pure air or diluted from 1:5 to 1:50 for more or less dusty air. This method gives a very much higher count than any other, since it includes the very numerous exceedingly minute particles, too small to be counted by other methods and probably of no significance hygienically. The discrepancy between this and most methods of counting is so great that no comparisons are possible. To determine the number of particles per cubic foot in very pure air, which can be counted undiluted, a multiplication factor of 3,963,100 must be used to estimate the number of particles per cubic foot, as is customary; whereas, with other counting methods, which make no attempt to count particles at the limit of vision, only decidedly dusty atmospheres give counts ranging in the millions. Ordinarily samples taken with the Aitken apparatus must be diluted from five to fifty times with filtered air for counting, this requiring additional multiplication of from five to fifty, bringing the totals up to hundreds of millions, more than is ever found by other methods. In addition to this factor of error, the small size of the sample and the fact that it is taken at a given instant, rather than during a time interval sufficiently long to allow for normal variations in dustiness due to varying currents and varying dust production in industrial processes, vitiates the value of a single test. This necessitates the wearisome tak-

ing of many tests in different locations and at different times, if one is to draw any conclusions from the results of tests. The Aitken counter indicates only the total number of particles present, giving no indication of relative size, shape, weight or chemical nature. Dr. Aitken's dust counter, as used by him, in studying the effects of air currents and of pollution by combustion products on dust distribution in the meeting room of the Royal Society of Edinburgh and in studying the effects of temperature and humidity variations on air dustiness in the open at Colmonell, give valuable information more easily obtained than by any of the other methods of air sampling suggested. The particular value of the Aitken dust counter is in the making of the count at the time of collection and directly in the apparatus in which the air sample is obtained.

With the Hill apparatus a decidedly larger sample is taken, air being drawn by a hand suction pump against a specially prepared varnished cover-glass. The volume of the sample ranges, according to Hill's directions, from 20 to 80 cubic inches, based on the capacity of the pump chamber and the number of strokes, but is reduced to from 10.0192 to 25.048 cubic inches when corrections are made for pump leakage, area of cover-glass counted and estimated efficiency of the method. The particles adhering to the cover-glass are counted under a low power microscope lens and here relative size and shape or particles can be seen, though Hill in his original article and on his "synthetic air charts" makes no reference to size differentiation. For the purpose of testing air washers delivering a steady current of air, this method should give very satisfactory results very simply and easily obtained, provided the percentage efficiency of 62 per cent as stated by Hill is correct, but this should be carefully tested and frequently checked. Whether the cover-glass retains an equal percentage of total particles in all instances is very doubtful. Where, on an average, only 62 per cent. of floating particles are retained in the first capsule, this percentage would certainly vary greatly, depending on the degree of dustiness, the force of the pump stroke and the specific gravity and size distribution of the dust particles. In calculating the volume of air aspirated based on the pump capacity, Hill makes an allowance of one-tenth volume for "leakage and space occupied by plunger rod" but the amount of leakage would depend somewhat on the force of the stroke and this is not controlable. He also counts particles not on the entire three-eighths of an inch cover-glass but on the portion "within the limits of the square of the ocular," which he figures as 80 per cent. of the cover-glass when using a No. 3 objective and a No. 1 eye-piece. The unequal distribution of particles, as shown in his photographic illustration, introduces another possible source of error, and the taking of only one sample at a time prevents the making of an average of a number of counts to correct this error as can be done with the Palmer method. For testing dwelling room, office or school room air with no continuing marked source of added dust, fairly accurate relative counts might be made if care were taken to use approximately the same speed of piston stroke in each case and without this if all six capsules supplied were used in tandem (but this would increase materially the work of the test), provided tests were taken in various locations in each room and an average or range determined. For the purpose of testing dust conditions in dusty trades and formulating standards for the same, this method also takes too small samples and samples during too short intervals to allow for changing conditions of dust production and variations in air currents. One obvious advantage of this method, where it is otherwise suitable, is the portability of the apparatus, its simplicity and independence of electric or other mechanical motive power for suction. Also the direct obtaining of a permanent record by mounting the cover-glass is of distinct value.

Dr. Graham-Rogers' method of aspiration of a measured volume of air past a glycerin covered plate is somewhat similar in principle but requires a motor of some kind, preferably electric, to supply aspirating force and a measurable air supply. On the other hand, larger samples can be taken and the sampling time is extended into periods of minutes. Graham-Rogers, himself, states that this method allows a greater proportion of smaller sized particles to escape and entrains rela-

tively more of the larger sizes. Here also the total number retained as well as the proportion of the different sizes depends on the force of the suction as well as on the character of the dust. Palmer, Coleman and Ward have shown that this method is distinctly less accurate than the Palmer apparatus and gives consistently lower counts.

As pointed out by Palmer, the use of sugar or other soluble filtering substance for entraining dust for counting is limited by the slowness of aspiration necessary, due to the resistance offered by the filtering material, and the possibility of there being insoluble particles already present in the sugar, though the error due to this latter factor is a small one in dusty atmospheres. The presence of the filtering substance in the solution may interfere with any chemical tests to be made on the dust or on the differentiation between organic and inorganic residue, as can be done with samples obtained with the Palmer apparatus, though thorough washing of the residue after filtration may remove this difficulty.

Where water bubbling is used (2) samples of several liters in size may be taken, but unless the bubbles are small and the rate of passage slow, many of the smaller dust particles will pass through in the bubbles and will not be included in the test. This method necessitates a suction pump of some type with a meter to measure air flow. Aspirating bottles give too slow a flow to enable a large sample to be taken, and a suction fan with direct connection, as in the Palmer method, would give too rapid a flow to entrain much dust.

The Palmer apparatus makes use of a small electrically driven centrifugal fan to aspirate air through a sample of water in a specially designed glass bulb, so constructed that the air is drawn through a fountain spray curtain of water which retains by actual test 98 per cent or more by weight of finely divided dust added at the intake. A rheostat controls the strength of the pull and the rate of flow is measured by a gasolene manometer connected with a venturi throat at the inlet as in the first models [see illustration in Palmer's article (3)], or between the water and the fan, as in the later models. The first apparatus described in the American Journal of Public Health had several mechanical defects which have been remedied in the later model, as supplied now by Wallace and Tiernan, but the principle has not been changed. The new apparatus is more compact and more rigid in its wooden case than was the first in a leather dress suit case. The outlet from the fan is placed on the top and not on the side near the intake, as at first. The latter position is much less likely to interfere with the air supply to the intake. The rate control by means of the sliding valve over the outlet to increase resistance is simpler and more easily regulated than the rheostat control in the first model, and, lastly, the collecting bulb is more easily detached for emptying and washing and the manometer is subject to less functuation than formerly. The efficiency of the apparatus as supplied for use with a 110-volt, direct or alternating current can be much increased for industrial work by the introduction of a four-point switch connecting with a 110-volt lamp in series with the motor, since many industrial plants making their own current supply a 200 to 220-volt current, which cannot be used with the apparatus as supplied by the manufacturer.

In using the Palmer apparatus in industrial tests, it is set up with the intake as nearly as possible at the level of the worker's head and so the sample will represent the normal dustiness to which the worker is exposed. After making the proper electrical connections, the motor is started and the fan run to aspirate five cubic feet of air per minute, the optimum rate for efficiency of the apparatus, and so run for from five to forty minutes, depending on the degree of dustiness and the turbidity observed in the water in the collecting bulb. From time to time fresh water must be added to replace loss by evaporation but this can be done without interrupting the test. The rate of evaporation is, of course, dependent on the relative humidity of the room and the need for more water can be told easily by an increase in rate as shown by the manometer scale. At the end of the collecting period the motor is stopped, the bulb disconnected and its contents discharged into a sampling bottle, best calibrated at the 100 c.c. mark, and the bulb rinsed out several times with fresh water, which is then added to the sample. To avoid any necessity for correction of results based on a control test of the water,

it is best to use distilled water filtered through a Berkefeld filter so as to be practically free from suspended matter and free from ponderable residue on evaporation. The residue from 100 c.c. of distilled water is negligible for the purposes of the test. For making the count, 1 c.c. is taken and either placed directly in a Sedgewick-Rafter cell or diluted, according to the turbidity of the sample. Dust counts are made with a ruled eyepiece and a low-power lens, counting the particles in ten areas, each representing the dust in 0.25 c.mm. of water. With 100 c.c. samples the total of the ten counts can be multiplied by 4000 and divided by the number of cubic feet of air sampled. If this is 100 cubic feet the multiplication factor thus becomes 400.

Owing to the volume of the air sampled and to the fact that the duration of the sampling period allows for normal variations, a fair estimate can be made of the amount of dust likely to be inhaled by a worker in his day's work. An average sample takes from 50 to 100 or 200 cubic feet of air during from ten to forty minutes. With a tidal air of 30 cubic inches and from 17 to 18 respirations per minute a man would inhale about 18 cubic feet per hour, or 144 cubic feet in an eight-hour day. With these figures as a basis, the total dust inhaled per diem and also the amount of poisonous dust inhaled can be easily estimated, as was done by Miller and Smyth (23). No comparative figures are available showing the relative efficiency of the Hill and the Palmer methods, but Hill's averages of 500 to 1500 particles per cubic foot for clean outdoor air and 10,000 to 30,000 per cubic foot in a mechanically ventilated schoolroom without air washers are far below any figures recorded for the Palmer apparatus, and are nearly in the same range as Palmer's figures obtained with the Graham-Rogers plate.

The Palmer apparatus owes its great superiority to the other methods of dust sampling so far devised, to several factors:—First, the size of the sample obtainable and the fact that collection can be continuous over sufficiently long intervals to allow for normal variations of dust producing and dust distributing conditions; second, the fact that sufficient dust is collected and collected in such a form that various methods of quantitative and qualitative examinations can be carried out on the same samples. This latter fact is a great advantage especially in the study of industrial dusts. No one method of examination can give us all the information necessary to correctly estimate the injuriousness or inocuousness of existing conditions of dustiness in any industry. With the Palmer apparatus counts can be made of the total number of particles in a given volume of air and the relative proportion of large and small particles can be determined. The nature of the particles can be noted, whether fibrous, amorphous, spiculate or crystalline. Solubility can be tested by comparative tests with water and with an oily or other collecting medium, as is being done at present in an investigation directed by the author. In similar processes, fair comparisons of dustiness can be easily made from turbidity readings of samples representing equal amounts of air (23), though this cannot be done with any degree of accuracy with dusts of different chemical or physical nature. The weight of dust in the sample can be determined by filtering 50 to 100 c.c. of the water through a Gouch crucible and drying to a constant weight, as recommended in the Standard methods (4), though this allows to escape unrecorded any water-soluble matter present in the dust, such as lead salts in lead industries, or any soluble organic substances which may be present, as in tests, not yet published, carried out under the author's direction in a plant manufacturing synthetic indigo. To insure the inclusion of soluble dusts in the total weight, a given amount of the water sample may be evaporated to dryness and the residue weighed, and it may then be incinerated to separate organic from mineral dusts. Sufficient sample can be obtained to permit of chemical tests for toxic or other substances present in the dust which might affect the health of workers, as was done in several instances by Miller and Smyth (23) (24). Permanent samples can be preserved or photographic records can be made showing the nature of the particles. By comparing count with weight and size distribution, an idea may be had as to the relative specific gravities of different dusts.

The Palmer apparatus is portable, easily set up, can be run at a fairly constant

rate and single tests give much more information than do single tests or multiple tests with any other method. With the addition of a 110 volt light bulb, as mentioned above, it can be run on any lighting current likely to be met with in industry, but an electric current is an essential and the apparatus is useless where there is none. Accurate counting requires some practice, and if size differentiation of particles is attempted different observers will vary somewhat in their counts, though after a little practice no great variation was noted by Miller and Smyth in their work (23). Size differentiation may be inaccurate with markedly hygroscopic dusts and some of these may show a tendency to cake and make the breaking up of clumps by shaking difficult or impossible. Miller and Smyth found this trouble in sampling cement dust which on standing in the water hydrated to form cakes or flocculent masses. Hill speaks of the likelihood of violent shaking of samples in liquids breaking up clumps to give more particles than were present in the air, but the author doubts if this causes as much error as would the clustering of particles on an adhesive surface such as Hill uses for collection. Dust counts can include all particles, or may exclude long fibres or large particles not likely to reach the bronchi and include only particles averaging one-fourth standard unit (.0001 sq. mm.) in area, as those most likely to be of interest hygienically.

Of the various methods proposed from time to time for the study of air dustiness, few have any great range of usefulness and a number are extremely inaccurate as absolutely quantitative tests, though all have some value as comparative methods when used under similar conditions with dusts of like nature. Colorimetric methods particularly are useless for comparing unlike dusts, as coal or soot and clay or textile dusts.

Condensation and diffraction methods are extremely accurate for minute quantities of air and experimentally to determine absolute freedom from floating matter, but are impractical for industrial dusts and conditions associated with changing air currents and varying dust production.

For estimating the total amount of dust, as, for example, the amount of coal and soot, precipitated over a given area, the simple method of collection in open vessels containing water as used by the Whipples gives information obtainable in no other way, but it gives no idea of the amount of dust suspended in the atmosphere at a given time. Weighing methods alone do not give complete information and do not indicate by themselves the nature of the dust or the size or number of the particles. Their special field of usefulness is in testing soluble and poisonous dusts.

Counting methods as used vary greatly in accuracy and in total numbers of particles counted by different methods. The Aitken counter gives the highest results but gives little size differentiation and includes ultramicroscopic particles of no hygienic significance.

Hill's and Graham-Rogers' methods give very low counts and apparently exclude most of the minute but visible particles which on account of their size and weight are most apt to reach the bronchioles and air cells and produce pulmonary fibrosis in the worker. For testing air washers and possibly for schoolrooms and offices, Hill's apparatus gives valuable information and certainly is the simplest and easiest method to operate, and requires no electric current or outside suction force.

High tension magnetic field dust-precipitation is not yet a practical method, owing to the lack of conveniently portable sampling apparatus supplying the high tension current essential to the process.

The sugar filter as used by Muir and Johnson (18) gives more information than does any other method except the Palmer, but requires more care and skill in carrying out, and there is more chance for error in the processes of solution, filtering, elutriation and counting. In one detail their method makes a determination not made by the Palmer method as recommended—*i.e.*, in the determination of the weight of the smaller particles up to 12 microns, though this determination could readily be made on the water sample from the Palmer sampler using the same technic as that employed by Muir and Johnson.

For range of usefulness and adaptability to varying conditions and for the amount and variety of information furnished, the Palmer water spray sampler with the modification proposed and used by the author gives results unobtainable

by any other method so far suggested. A single sampling will furnish data for determining the amount of dust by weight in a given air volume, the number of dust particles per unit volume, the size distribution of particles, the relative volume of dust as shown by turbidity readings on water samples, the relative amounts of organic and inorganic matters in the dust and the physical and chemical nature of the particles.

With the aid of tests made with this apparatus, the U. S. Public Health Service, Division of Industrial Hygiene and Medicine, are endeavoring to formulate maximum standards of permissible dustiness in various industries, based on the count and weight of samples and the physical and chemical nature of the dusts encountered. Tentative standards for the abrasive industry were suggested by Professor C. E. A. Winslow in a paper read by him before the Industrial Hygiene Section of the American Public Health Association held in Chicago in December, 1918 (25).

Conclusions

1. No single method of air sampling for dust content, as yet devised, is ideal but several methods are particularly adapted to special conditions, and a number have distinct fields of usefulness.

2. The essentials of a satisfactory method for making a quantitative dust test are: (a) an aspirating force capable of accurate measurement of the amount of air aspirated per unit of time or per pump stroke; (b) a receptacle for retaining dust particles which will retain practically all of the particles from one-half to 50 microns in diameter; (c) a satisfactory method of making the required tests on the sample as collected.

3. In studying industrial dusts sampling must cover sufficient time intervals to allow for normal variations in dust production and dust distribution and collections should be made as nearly as possible from the working level. The larger the sample and the longer the period of sampling the less the probable errors of the method.

4. With dusts containing poisonous substances, samples must be large enough to permit of accurate chemical tests.

5. For studying industrial dust conditions weight determinations alone do not give sufficient information, except possibly with soluble poisonous dusts.

6. For complete studies and for fixing of permissible limits of dustiness, tests must permit of estimating weights and counts and determinations of the physical and chemical nature and size of dust particles. These tests are at present best and most easily made on samples collected with the Palmer apparatus, though the sugar filter samples treated according to Muir and Johnson's technic give as much information.

7. Other tests of distinct value are colorimetric tests with cloth screens, the Hill capsules and pump, the Aitken dust counter, the cotton filter as used by Duckering, and the precipitation method of the Whipples.

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BACK STRAIN—AN ACCIDENT OR A DISEASE?*

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THE specialty I represent appreciates deeply, gentlemen, the opportunity of participating in your scientific sessions. Orthopedic surgeons serving with the A. E. F. were trusted with the working out of certain problems. These problems, roughly speaking, were the lesions of the extremities and spinal column, both pre-combat and post-combat. Greatly helped by this experience, the specialty is eager to be of more service in peace, convinced that there is no essential difference between certain static and traumatic conditions of civil life and the lesions of the extremities and spinal column which result from pre-combat and combat army life. Perhaps the majority of these lesions in civil life are the results of industrial conditions and industrial accidents. No symptoms are more common, none are less intelligently treated, than those grouped under the term of "Back Strain." You have given me a subject in the form of a question. I do not believe the question can be answered simply, but in the time allotted an attempt will be made to indicate the lines along which the analysis of any given case must proceed and to demonstrate some of the factors which contribute to the complexity of the solution. We shall discuss, briefly, the so-called static conditions which are known to give rise to the symptoms of back strain. Then by means of lantern slides we shall show you a few of the common and more typical lesions and try to emphasize the fact that combinations of structural abnormalities with static or traumatic strains are frequently found. We shall suggest that the complete relief of these symptoms is often accomplished only by appreciating that the recent and perhaps trivial strain may be superimposed upon a structural defect, which up to the time of the accident had been unsuspected and unfelt.

I. STATIC CONDITIONS

Under this heading we shall group the symptoms that may occur as the result of:

(a) Faulty posture acquired probably in childhood and accentuated in adult life.

(b) Faulty positions in which work is done.

(c) The combination of some pelvic disease, vertebral abnormality or acute strain with faulty posture or a faulty position of work.

(a) Faulty Posture.

These postures mean faulty mechanics for the erect position and a lessened resistance which results in fatigue amounting at times to acute strain. We must not forget also, that foot-strain often gives rise to back pain as the back muscles attempt to accommodate.

(b) Faulty Positions of Work.

The tiring effort of the neck and lower back muscles to assist a poor occular focus is familiar to the ophthalmologist; the stenographer's chair which offers no support to the back; the low desk of the draftsman or the low bench of the workman; the cramped positions of miners in the low coal galleries may serve as examples of occupational back strain and need no comment.

(c) The obscure occupational backs are those which fail to completely recover when postural strain is relieved by supports, by the correction of vision, or by correcting conditions of work. Rest surely relieves, but symptoms recur and we must look for combinations or for complications of pelvic or prostatic disease, arthritis or congenital abnormalities.

It has long been recognized that sciatica is less definite a diagnosis than rheumatism, and in nearly all low-back lesions, it is a common symptom and usually only a symptom. It may be associated with tenderness along the course of the nerve or portions of the nerve. Almost never in a so-called sciatica do we find the muscular weakness which accompanies a true neuritis. In our opinion, a true localized neuritis of the sciatic nerve is as rare as that of the other main trunks.

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Fig. 1-a.—Reconstructed lumbo-sacral and sacro-iliac region in accordance with supposedly normal standards. (See key.)
Kindness of Dr. Arial W. George, Boston.

Fig. 1-b.—Reconstructed lumbo-sacral and sacro-iliac region in accordance with supposedly normal standards. (See key.)
Kindness of Dr. Arial W. George, Boston.

Key

1. Anterior superior border, 5th lumbar vertebra.
2. Posterior superior border, 5th lumbar vertebra
3. Lamina, 5th lumbar vertebra.
4. Spinous process, 4th lumbar vertebra.
5. Spinous process, 5th lumbar vertebra.
6. Inferior articular process, 4th lumbar vertebra.
7. Superior articular process, 5th lumbar vertebra.
8. Inferior articular process, 5th lumbar vertebra.
9. Superior articular process, sacrum.
10. Anterior border, 3rd lumbar vertebra.
11. Anterior inferior border, 5th lumbar vertebra.
12. Posterior inferior border, 5th lumbar vertebra.
13. Posterior inferior border, 3rd lumbar vertebra.
14. Prominence of the sacrum.
15. Superior border of the sacrum posteriorly.

ss Spinous process of sacrum.
tr. Transverse process

These numbers correspond in the antero-posterior and lateral views.

II. CONGENITAL ABNORMALITIES
(Figs. 1, 2, 3, 4 and 5)

Until Böhm and Goldthwait focused attention on the extreme frequency of the congenital abnormalities of the low spine, we had been recognizing only the gross lesions of wedge shaped vertebrae or a marked spina bifida or an occasional cervical rib. Since we have been scrutinizing the X-rays of lumbar spines and sacro-iliac joints we find it rather difficult to determine a standard for the normal in this region, so varied in shape are the elements. Reviewing hundreds of plates taken in the Massachusetts General Hospital, for all sorts of conditions including suspected kidney, bladder, pelvic and prostatic lesions, less than half could be said to show completely normal bony outlines, even using the term with generous latitude.

Many of us here present would show these abnormalities and it is to be hoped we will remain in ignorance of their existence. Some of them are sources of strength rather than weakness, but once an accident occurs which produces a strain, we must be sure that their existence does not complicate the lesion or call for a mechanical treatment which must take cognizance of them and may differ from the mechanical treatment indicated in a so-called normal case.

III. ACCIDENTS

(a) Simple muscular or ligamentous strain.

Muscular strain is probably the com-

Fig. 2.—Abnormally shaped transverse process of the last lumbar vertebra suggesting an articulation between it and the top of the sacrum. Hypertrophic changes between the 4th and 5th lumbar vertebræ.

Fig. 3.—Six lumbar vertebræ. Note articulation between spinous processes of 4th and 5th lumbar.

monest industrial lesion. Recovery is usually quick under simple rest, whether or not this rest is accompanied by the use of the well-advertised liniments to which the recovery is usually ascribed. Sometimes the symptoms from these traumatic lesions are persistent. A direct blow may seriously damage muscle fibres or a hematoma may leave unusually strong adhesions after it has been organized. A rupture of a few fibres of an origin or insertion to a spinous or transverse process, or of the attachment of the lumbar aponeurosis to the sacrum or iliac crest, may continue to be a painful or irritating spot, analagous to the discouraging tennis elbows and golfers' wrists of civil life. Complete immobilization for six weeks, followed by a gradual but persistent use, is often the shortest road to recovery in back lesions of this sort, as it is in tennis elbows.

(b) A true sprain of the strong vertebral interspinous or articular ligaments or a tear of a portion of the lumbar aponeurosis is more rare and more serious. These lesions are sharply localized and require efficient immobilization. The lumbo-sacral and sacro-iliac ligaments seem to be subject to strain, to which they yield more commonly than the others. Cases are on record of the rupture of the intervertebral disc with the protrusion of the corpus spongiosum causing an actual pressure on the cauda equina. This must be extremely rare.

Sciatica is again a very frequent symptom of these lesions, especially of the lumbo-sacral and sacro-iliac group.

(c) Ligamentous rupture or relaxation associated with displacement.

Fig. 4.—Partially sacralized last lumbar vertebra, causing extreme asymmetry of the sacro-iliac joints and the articulation between the 4th and 5th lumbar.

Slight displacements.—We must admit, I believe, the existence of vertebral displacements or mal-alignments, sometimes demonstrable by the X-rays and sometimes not. I am personally in doubt whether these displacements are connected with the symptoms as cause or as effect. The frequent marked and symptomless mal-alignments of scoliosis suggest that they are usually the effect. Nothing can persuade our friends of the osteopathic school, that the true cause is not the slight displacements which they honestly believe they can palpate and correct by repeated manipulations. The fact that the symptoms frequently disappear under their treatment is proof enough to them. However, after an entirely honest and fairly thorough attempt, sympathetically aided by some of their best practitioners, I have been unable to satisfy myself of this causal relation, nor have I been able to prove conclusively the existence of the displacements which they were certain they could palpate.

Spondylolisthesis. (Figs. 6 and 7.)—The relaxed lumbar spine, lumbo-sacral or sacro-iliac joints, pivotal as these structures are in the erect biped, may quite as well give symptoms as relaxed knee joints or relaxed feet. It is a question of the strength of the supporting muscles. The contortionist as a rule is free from back strain. If one or two structures in a joint mechanism are weak while the others are strong, we shall surely have symptoms. The typical example of this is in the lumbo-sacral joint, with the thrust of the body weight ever tending to push the fifth lumbar forward in front of the sacrum. We do well, however, to remind ourselves of Sir Arbuthnot Lane's comment on the scholarly monograph of Neugebauer on spondylolisthesis, reporting a comparatively small number of supposedly unique specimens. Lane said "Every coal heaver I ever dissected had spondylolisthesis." The lesion is not difficult to detect. In backs with poor musculature, it is a cause of constant or recurring discomfort, and it is not easy to relieve speedily without a fixative operation on the spine.

Fig. 5.—Spina bifida. Failure of neural arch to close in last two lumbar vertebræ and entire sacrum.

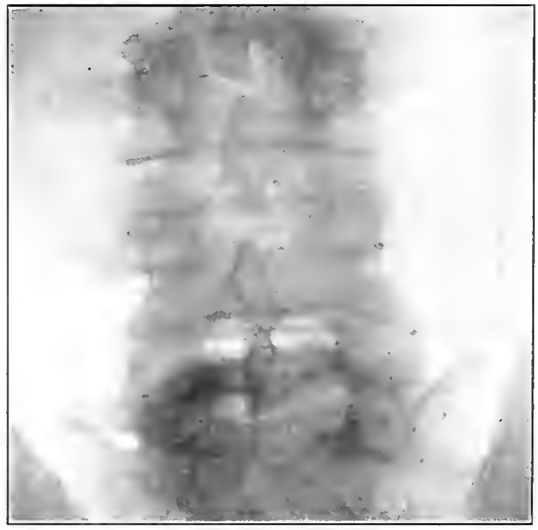

Fig. 6.—Abnormal position of the 5th lumbar suggesting an early spondylolisthesis. Note the impingement of the spinous processes of the 4th and 5th lumbar vertebræ.

Sacro-iliac lesions.—Although I admit without regret that I was a partner in what I believe was a sort of a rediscovery of displacements and relaxations of the sacro-iliac joint as a common cause of back strain, no one regrets more than Colonel Goldthwait and I the carelessness with which the diagnosis of "sacro-iliac disease" is made today. It does, of course, exist—tuberculosis, chronic arthritis, malignant disease—but it is no entity and as the term is being used, it

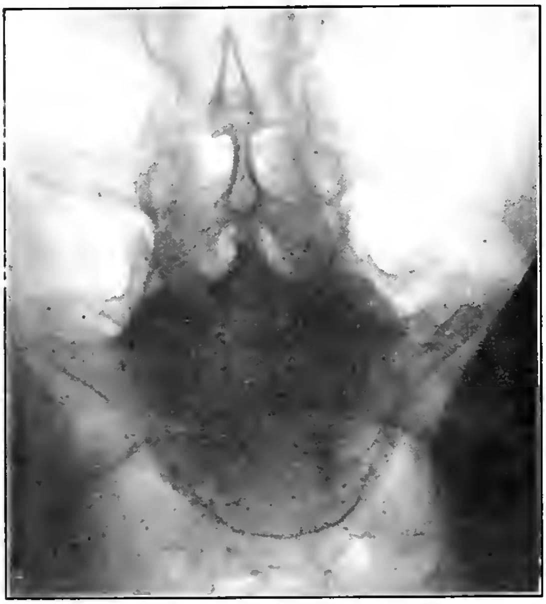

FIG. 7.—Complete spondylolisthesis. Note shadow of body of 5th lumbar vertebra completely anterior to sacrum, its superior surface facing forward.

means nothing. That the normal joint has motion in it, can be demonstrated by dissection or by stereoscopic X-rays. That the amount of motion is variable in different individuals is a fact also. That lack of normal motion is often quite as likely to give symptoms as hypermobility is probably true. Actual displacements, slight and considerable, do occur. Many of them are reducible in their early stages by forcible manipulations at one sitting with or without an anaesthetic, or by repeated less strenuous active or passive movements. Old, irreducible displacements often become symptomless. If a sacro-iliac joint is to be protected, an accurate knowledge of its anatomy is necessary. Lateral pressure on the iliac crests springs it apart. The Italian laborer, when he digs, shifts his belt from his waist line to the level included between his trochanters and his anterior superior spines. He has learned his anatomy, if not the nomenclature, from his symptoms.

Sciatic scoliosis is a term almost as nondescriptive of the cause as sacro-iliac disease. Various lesions of the muscles, of the lumbo-sacral and sacro-iliac joints may give rise to the phenomenon. Most of the literature under this heading is German and the best discussion of the symptom-complex and its varied treatment in English, is by Bucholz, writing from the clinic of the Massachusetts General Hospital.

Sciatic pain again in all these lesions is a frequent precursor of the diagnosis, a concomitant of the recognized lesion or a persistent sequela of the reduced displacement.

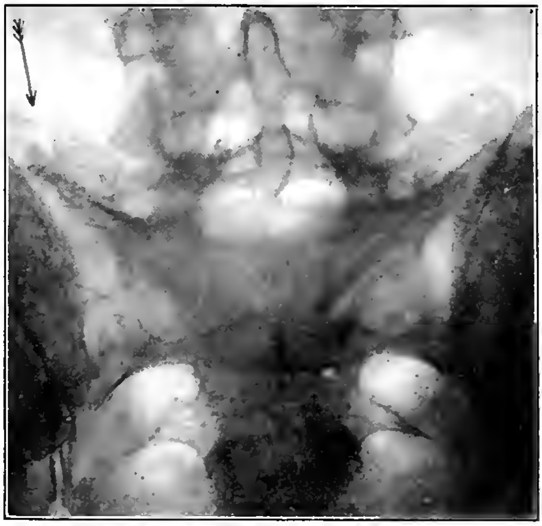

FIG. 8.—Fracture of tip of transverse process of the 5th lumbar vertebra.

(d) Fractures. (Figs. 8 and 9.)

(1) Fractures of the vertebral processes and articular facets, or of the transverse or spinous processes are not as uncommon as is their diagnosis without the X-ray. Fracture of an articular process or processes frequently leaves a region of rigidity and may give pressure symptoms from the accompanying effusion. Fractures of the transverse or spinous processes recover if immobilized, but often remain un-united and painful if not recognized and not treated.

(2) Fractures of the bodies are also much more common than we have believed and the typical slight compression fracture of the spongy vertebrae which firmly impacts is surprisingly devoid of early symptoms. Their significance lies in the subsequently stiffened area and in the tendency to slow over-production of bone which frequently takes place as the result of unprotected activity. This so-called Verneuil's disease may produce an irritative myelitis whose onset may be months or even years after the original

trauma. By early and rather prolonged immobilization the danger is often escaped. Operative immobilization of the area may well be the safest treatment in the laboring man.

(3) A word should be said here again concerning the importance of recognizing the existence of a congenital abnormality or an acquired disease in connection with the traumatic lesion. Different leverages are frequently produced and adjustments of the weight-bearing mechanism and muscular action are necessary. This new condition, plus the old lesion, requires nice appreciation of the mechanics, if relief from weakness and pain is to be obtained.

IV. DISEASE

(a) Lumbago. We will leave the acute myositis, which perhaps alone ought to be allowed this name, to the internists. The name is perhaps not as frequently misused as sciatica, but its abuse is still a reproach.

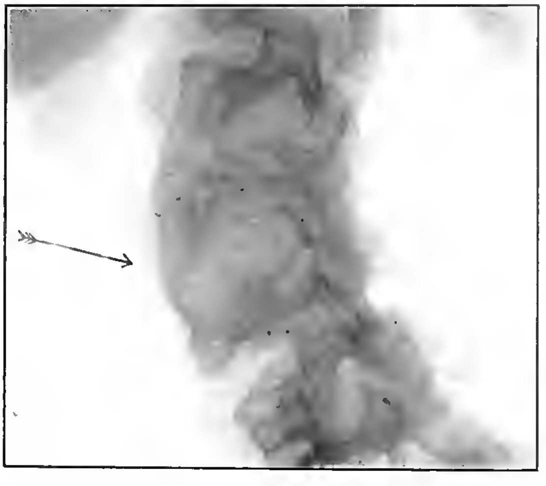

FIG. 9.—Asymmetrical fusion of the 3rd and 4th lumbar vertebræ; probably congenital abnormality or old compression fracture.

(b) Non-tubercular arthritis of the spine is of various types. (Fig. 10.)

Acute infectious arthritis sometimes accompanies a Neisser infection or a typhoid. We see, not infrequently, the chronic poker backs of the so-called Strümpel-Marie or rhizomyelitic type, in which the articular processes first anchylose and the spine and root joints of the shoulder and hip become fixed by bony union.

More common by far in persons beyond middle age, is the hypertrophic type with beak-like processes starting from the edges of the bodies of the vertebrae and involving frequently the articular processes and sacro-iliac joints. It frequently gives rise to few symptoms other than diminished flexibility, though it rarely produces complete anchylosis.

(c) Tuberculosis (Figs. 11 and 12) in the form of Pott's disease is far less easily diagnosed in the adult than in the child. Our own failures to make the diagnosis have, we trust, led us to be very wary. There is often no kyphos and there are often few typical symptoms. The lesion and the surrounding abscess shadow are discovered at times only by the X-ray. When a disease attacks the sacro-iliac joints, it is often most misleading and with our present greater familiarity with non-tuberculous lesions of these joints, we are often likely to forget the very real possibility of these more serious conditions.

Under appropriate rest by recumbency and mechanical or operative measures, tuberculosis of the sacro-iliac joints is by no means always fatal, and recovery is frequently extremely satisfactory. The seemingly healed tuberculous lesion is not unlikely to have exacerbations for many years following any slight trauma. Painter's paper on the malignancy of bone tuberculosis has a distinct bearing on the prognosis, especially in its relation to industrial conditions.

(d) Syphilis of the spine is either much

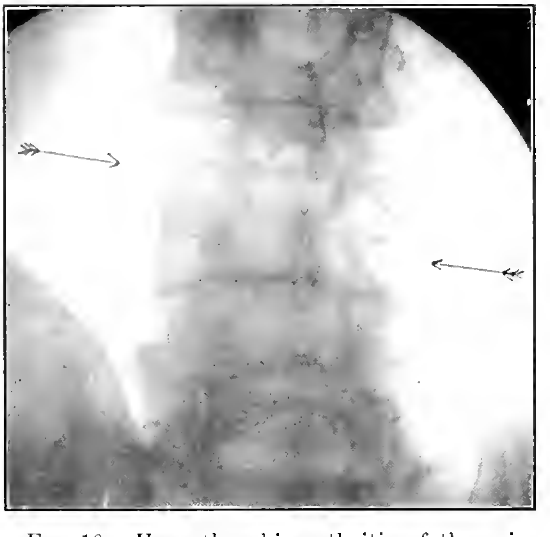

FIG. 10.—Hyperthrophic arthritis of the spine. Note the marked speculation on the right of the picture and the early changes on the left.

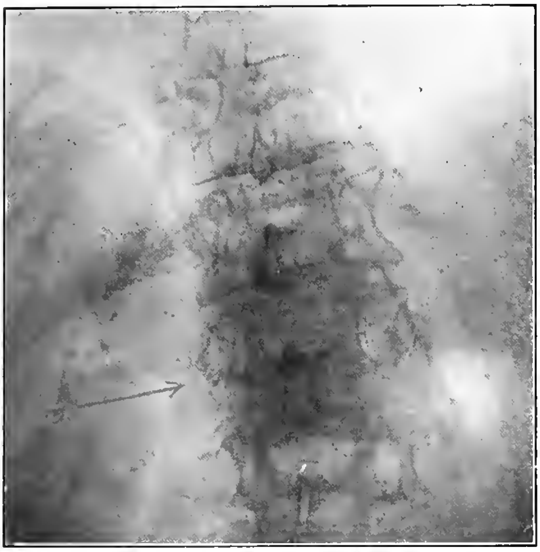

Fig. 11.—Extreme structural atrophy of vertebræ in connection with tuberculosis of the spine. Lesion between the 1st and 2d lumbar vertebræ.

less commonly recognized in certain sections of the country than in others, or is actually in these sections less common. It is a frequent diagnosis on the Pacific Coast and a rare one on the Atlantic. Congenital syphilis, as well as acquired, is difficult without the Wasserman test to differentiate from tuberculosis, but its response to treatment, of course, is quite different. Tabetic lesions of the vertebrae have long been recognized. They are not common, but they should not be forgotten.

(e) Osteomyelitis (Fig. 13) is usually acute in its onset, and its outcome depends upon whether the bodies or the articular processes and the laminae are the seat of the infection. If the disease is in the bodies, the abscess frequently ruptures anteriorly, infects the viscera and is fatal. In the processes or laminae the disease may be drained posteriorly.

(f) Neoplasms (Fig. 14) must be mentioned in connection with back strain, and especially with relation to sciatic pain. Bilateral sciatic pain is rare in static and traumatic strain. It is common in spinal cord tumors and malignant disease of the bones. Epithelioma of the bones always represents a metastasis. The extreme punctate atrophy of a chronic tuberculosis may be mistaken for myelomata. Small, round-celled sarcoma, we have personally seen very rarely, if ever, in the spine. We have seen occasionally a giant cell sarcoma or as it has been recently called, hemorrhagic osteomyelitis.

(g) Under this heading of disease we must mention the group of so-called functional or hysterical backs. In the absence of fairly definite stigmata this diagnosis should rarely be made. Railroad spines may have occurred as a result of railroad accidents, but the name is not descriptive of a typical picture. The diagnosis of functional spine is almost as rarely justifiable as neurasthenia.

Summary

To answer the question of the title "Back Strain—An Accident or a Disease?" we may say either or neither or both. Having been paid our patients' or our companies' money, we must make our choice. The choice may today be based on knowledge and not on surmise. We must approach the choice without preconceived notions. We must refuse to consider our duty done when we make a diagnosis of lumbago or sciatica or back strain, or I regret to say, nowadays, of sacro-iliac disease or railroad spine.

Unless we make the most careful examination and unless we employ the most accurate diagnostic methods we shall continue to be puzzled by the persistence of the symptoms and our patients will continue to seek and often obtain osteopathic, chiropractic and nostrum relief. We must know why and when and how to

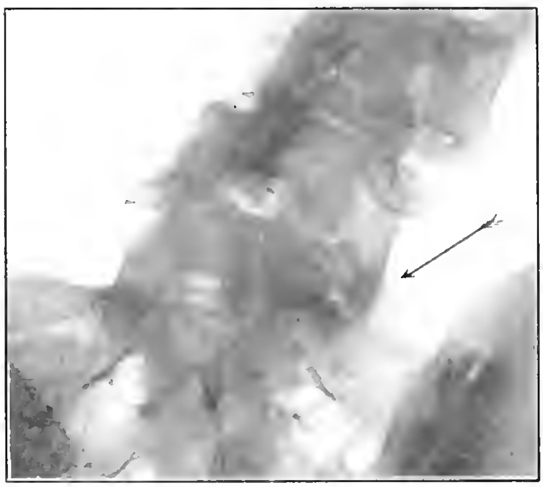

Fig. 12.—Old asymmetrical disease, probably healed tuberculosis, between 4th and 5th lumbar vertebræ. Note marked scoliosis as a result.

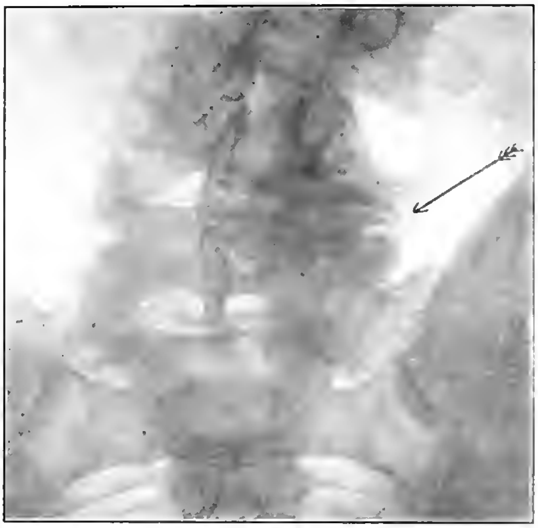

FIG. 13.—The osteomyelitis or Charcot vertebræ. Possibly an old fracture.

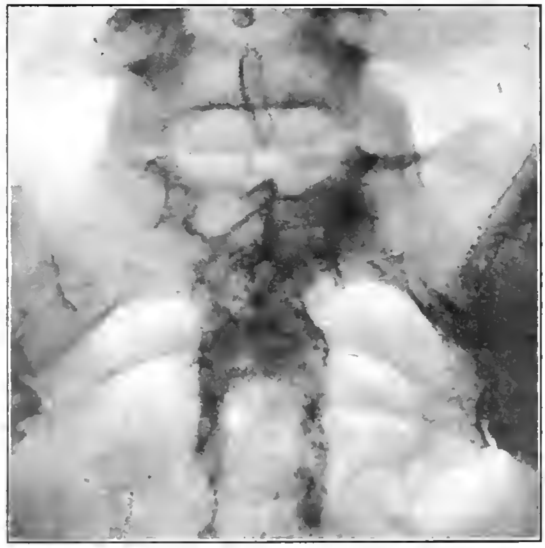

FIG. 14.—Diffuse epithelioma of the ilia and sacrum from metastases. (Morrison.)

protect, and why and when and how to exercise. Forcible manipulation is not without danger nor is a back brace a panacea.

I trust, gentlemen, I have left the sense of confusion in your minds. Until we sense this confusion we cannot begin to be clear-headed. But there must be a way out of our confusion and it is necessary that we find it. The considerations we have merely suggested seem to us the necessary first steps toward our emergence.

I want to leave with you this: That the diagnosis of hysterical spine should rarely be made; that the diagnosis of railroad spine means nothing; that the diagnosis of functional spine is usually a confession of our ignorance of the true cause of the trouble. My experience in medico-legal cases is not extensive, but it is large enough to have made me blush for the surgeon who contents himself with the diagnosis of sciatica or lumbago or functional spine, the nature of which neither the patient, the jury, nor the surgeon himself can understand. On the other hand, the plaintiff's lawyer or physician may demonstrate clearly by X-rays the separation of the sacro-iliac joints or the displacement, and secure his verdict by proving to the uninitiated jury his contention. *We* may know that the separation he points out is entirely within normal limits. *We* may know that it has probably nothing to do with the symptoms. *We* may know that the displacement he demonstrates is due to the asymmetry of the X-ray tube and not to the asymmetry of the patient, but *we* should be the first to demonstrate these facts. Only the careful analysis of each case and the knowledge of the normal and the commonly symptomless variations will allow us to do so. We shall advance neither the interest of science nor of our patients nor of the companies we represent until we take time to analyze thus our cases of back strain.

I wish to express my thanks to Drs. Morrison and George of Boston, for several of the X-ray plates and lantern slides.

IS WAR TIME SURGERY APPLICABLE TO INDUSTRIAL SURGERY? *

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WAR surgery in the Evacuation Hospital zone was essentially the surgery of extensive lacerated wounds and compound fractures, this group comprising about 90 per cent. of all the lesions produced by shell, machine gun and rifle fire. The main impression that I received of high explosive wounds was their multiplicity and their extent, for it was rare to find only one wound or a wound that failed to look as if a dissection had been attained, many of them producing an exposure as if in a biopsy.

The immediate complications of war wounds were shock and infection. The shock often was due to blood-loss in combination with cold, exposure, hunger, thirst and exhaustion. The infection was frequently of the gas bacillus or other anerobic type, although for the most part the ordinary pus producing staphylococci and streptococci prevailed. We actually dreaded the streptococcus more than the gas bacillus for it was more common, more resistant and persistent, practically always present in bone infections. The lesions of the organs within the skull, thorax and abdomen were fairly numerous and they also were characterized by their multiplicity and severity. Of all war injuries, I believe those of the skull and abdomen more closely paralleled civil injuries than any others because only those relatively minor survived long enough to reach us in our forward zone. Chest wounds were unique and of a type almost never seen in civil practice and much to our surprise and satisfaction many of them did surprisingly well when subjected to the special technic devised for their relief. Joint wounds were also treated after a new method and they likewise responded well. Purposely I have said nothing as to vascular or neural injuries, for their treatment is quite similar to the less grave injuries of civil life.

The adaptation of war surgery lesions to those of industrial surgery finds no *exact* parallel because of the marked difference in their causation, the inherent differences in the types of infection and the all important element of the time elapsing between the onset of injury and the receipt of the patient. One other salient factor is the age and physique incidence of the soldier patient as compared with the patient in civil life. This is a cardinal difference to which must be added the morale of the soldier, the will to get well, an attribute all important in the outcome. Our patients in civil life are often beyond the draft age, their physique is often below par, their vitality often has been affected by disease, malnutrition or by alcohol. The soldier patient has an asset in his youthful, sturdy physique; the civil patient often has a pathological deficit to which the injury adds another burden.

This brief review prepares the way to answer in the affirmative the inquiry propounded by the title of this paper. War surgery is applicable to industrial surgery in the following particulars:

I. *Wounds.* Experience taught us that infection was the only real foe to primary union and that if we could rid the wound of devitalized tissue, healing would proceed favorably because germs could not live in healthy surroundings. This lead to what is termed "mechanical sterilization," as distinguished from "chemical sterilization." The former means that with the knife and scissors all damaged tissue is removed until the part looks healthy, until it bleeds and until muscle contracts. This process of cutting away is known as "Debridement" (literally unbridling) and only such parts are removed as are manifestly unhealthy. It cannot be stated too strongly that this form of sterilization is not sacrificial and that the process is more like paring the surface than exsection of it. In cases thus treated within the first

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18 hours, experience showed that primary suture could be made with safety and success. Cases arriving after the 18-hour period were treated in the same way, but the suturing was postponed until between the third and sixth day, bacteriologic tests meanwhile proving the presence or absence of streptococci. If these germs were absent even if others were present, this "delayed primary suture" method (or "primo-secondary" suture) would prove successful if the wound appeared clinically healthy.

Wounds received late and already suppurating must be subjected to the procedure known as "chemical sterilization," and when relatively pus free they too can be sutured, the method being known as "secondary suture." Mechanical sterilization may be termed the aseptic method; chemical sterilization the antiseptic method. Antiseptics of many kinds were employed either in the form of the familiar wet dressings or by intermittent instillation after the method of Carrel, using the hypochlorite solution of Dakin made after Daufresne's formula.

The application of these methods to civil surgery is very easy and is called for principally in lacerated wounds associated with bruising or fraying of the soft parts. The vast majority of industrial accidents are cared for promptly and the types of infection are relatively less virulent; therefore the essential element in success is to rid the wound of contained infection by debridement or antiseptics, bearing in mind the possibility of re-infection unless our procedures are carried out with every aseptic detail.

I would emphasize the need for exploring the entire wound under the guidance of the eye, clearing out of it all foreign material, stopping hemorrhage, and then flooding it with full strength iodine before suturing. This applies to the ordinary wound in which the edges do not require paring because they are neither bruised nor frayed. I believe that every wound so sutured should be drained by a strand of silkworm gut or rubber, the drain to be removed in 24-48 hours. If there is any question as to the sterility of the wound at that time, the secretion at the inner end of the drain can be examined and the exact nature of the organisms definitely determined. For wounds already infected, gaping or with open surfaces, there is no better treatment than the Carrel-Dakin procedure. This unfortunately requires special preparation of the solution and a special technic for the application of it. The proper carrying out of this technic is in effect an aseptic operation, it requires training, it is time consuming and it therefore cannot have wide application. Aside from the value of the solution, I believe that one of the great elements in the success of the method is the care with which it has to be applied and the improbability of re-infecting a wound by contact with soiled instruments or fingers. Failure to sterilize an ordinary wound by this treatment is to be charged more to the surgeon than to the method. To use the Carrel-Dakin ritual is not the road to wound salvation unless all the precepts are carefully followed. In this connection it is profitable to state an item of war experience to the effect that persistent streptococci infection usually means the presence of infected bone; and that persisting discharge usually means the presence of a foreign body, often frayed or otherwise devitalized soft parts.

II. *Fractures* should be much better treated in future as a result of war experience, not only because a compound fracture can be converted into a simple fracture by primary or delayed primary suture, but also because the profession in general have become aroused to the importance and technical difficulty of this branch of surgery. Industrial surgeons have long recognized the need for better care of this class of case even as they have realized that the treatment requires more skill and judgment than is ordinarily needed to remove an interval appendix or to perform a herniotomy. The various splints used for war fractures of the long bones should have a wide application. First-aid men should and can be taught to apply Thomas splints for the arm or leg and these same appliances with appropriate overhead frames can be used for the treatment of nearly all the fractures of the extremities. In the treatment of broken bones it is important to recognize that there are two grades or classes, speaking generally. One class is what may be termed the *displaced variety*, the other the *non-displaced variety*. The sec-

ond class requires little if any attempts at reduction or setting and our only concern is to keep the part at rest by suitable splintage. The other class, however, requires setting of the displaced fragments before we can expect a splint to be of service. In war experience practically all the cases were of this displaced type, badly compounded and comminuted for the most part. Many limbs were saved by rigidly applying mechanical sterilization technic to the soft parts, removing bone fragments that were devitalized or detached. This same principle is applicable to civil surgery and no limb should be amputated unless the main vascular supply has been severed, the main bone is hopelessly pulpified, or infection is of such a grade that systemic symptoms are present.

Fracture of the femur was the greatest fracture problem of the war and the majority of surgeons in fracture centres came to rely more and more upon traction applied to the bone itself rather than when applied to the soft parts overlying the bone. The English surgeons advocated the calipers traction device (known to us as the "icetongs") and I saw this in use in some of the British hospitals during a visit to England and Scotland after the armistice was declared. This is a simpler method than the Steinmann nail and the application can be made under local anesthesia.

The Finiochetto stirrup is used by some French surgeons for the treatment of all fractures of the lower extremity, as this device when placed over the concavity of the os calcis produces a very considerable traction on the whole lower extremity. The Chutro or Hawley modification makes the introduction rather easier and more exact. The calipers and stirrup will be for me standard methods of treatment in lower extremity fractures to the exclusion of all other means in selected cases.

Too much stress cannot be placed on the fact that in a fracture the broken bone is only one part of the damage inflicted, and that the associated injuries to the soft parts and joints are often more important. This means that after a broken bone is suitably reduced and splinted, our main treatment should be directed toward the associated lesions in the contiguous parts. The day has gone by when we can discharge our patient as cured when union has been attained. I believe we do most for the patient when we place the fractured bone in a splint that gives access to the limb for massage and motion designed to prevent atrophy, and the adhesions growing out of teno-synovitis, synovitis and arthritis. There are few fractures once set in which massage and motion are contra-indicated from the very beginning of treatment. There are "three R's" in fracture treatment, namely, Reduction, Retention and Restoration, and of these three the last named is really the most important and yet the most neglected. The restorative, re-educative or reconstructive side of war surgery should and can be carried on into civil surgery, but the prevention of much of the crippling from fractures can only be attained by recognizing that while reduction and retention are necessary preliminaries, restoration of function should begin early and not after the fracture has healed. Let us not forget also that deformity of bone does not necessarily mean diminution of function. Witness the almost constant deformity following fracture of the clavicle with perfect function of the shoulder if we do not immobilize the joint until we virtually seal it by too long fixation.

III. *Joint Injuries* in war taught us many valuable clinical facts to which Willems of Belgium, in particular, called our attention. It has now been demonstrated that the synovial lining of a joint is capable of standing a relatively large amount of trauma and in that respect as in others it resembles the peritoneum.

Joint penetration as from recent wounds or foreign bodies is now treated in precisely the same way as wounds of the soft parts, that is by the mechanical sterilization which cuts away sparingly the tract leading to the joint so that nothing but a healthy surface is left. Ether is then used to wash out the joint cavity, all bleeding is stopped and the synovial membrane is separately sewed, then the muscle-fascial layer alone, and finally the skin. No drainage whatever is used. Then instead of putting the joint at rest in a splint, only a soft dressing is applied and the patient is made to move the joint each day through increasingly wide angles. In a joint already the site of sep-

tic arthritis, a lateral or bilateral incision is made giving access to the joint interior, it is washed out with ether and again no drainage is inserted, but instead the patient is forced to move the articulation so that the normal flexion and extension literally squirts the pus out of the joint cavity. In a septic knee, the patient is made to walk; in an elbow, exercises are prescribed enforcing bending and straightening the arm and forearm. No splintage of any kind is used and motion is the key note of success as opposed to rest. This type of treatment has an application in many civil injuries and it is based on enough experience to warrant advocacy. Ordinary synovitis of the knee will in future be treated by me by lateral aspiration until all the fluid is removed and then the patient will be made to walk. Re-effusion will be treated by aspiration as often as may be necessary and in this way the disability period should be much lessened and I feel sure there will be far less stiffness from prolonged immobilization. In civil life this procedure of immediate mobilization was long ago successfully used in the treatment of a sprained ankle and the principle has now a very much wider application.

IV. *Blood Vessel Injuries* in some cases were successfully treated by placing over the puncture a flap of fascia and this procedure may have a limited application in civil life. Some French surgeons have reported a few successful cases in which an elbowed silver or glass tube has been placed in the lumen of a main vessel to bridge a gap until collateral circulation has been restored.

V. *Nerve Injuries* were exceedingly numerous but in general the outcome of suture has been disappointing inasmuch as a very long period ensues before restoration occurs. The best practice seems to be to have the separated ends free of any fibrous tissue, to join them by numerous fine silk threads and not to wrap the place of junction in fascia or any other material. The application of this newer type of neurorrhaphy to civil life is of course quite evident. When a gap exists, the external cutaneous nerve of the subject is usually chosen to bridge the defect. In the musculo-spiral and in the peroneal types of involvement, transplantation of tendons at the respective joints is a favorite method as this can be done at once so that the wrist drop and ankle drop may be overcome more promptly than if neurorrhaphy alone was done.

VI. *Visceral Injury.* In the *skull*, foreign bodies are brought into better view if a soft rubber catheter is introduced into the wound tract and through this large amounts of sterile water are poured and thus pulpified brain tissue is removed by hydraulic pressure. A number of these cases have been operated upon under local anesthesia and experience seems to indicate that primary closure of the dura and skull should be made, when possible.

I know of nothing new in connection with the treatment of fractured skull, except that in certain cases with mounting blood pressure, relief is sometimes obtained by repeated spinal taps. The same applies to the delirium seen with head injury and to the headache so often complained of. For hernia cerebri, spinal tapping should be energetically tried before operation is attempted.

In *thoracic surgery* a new chapter has been written and this cavity is no longer a zone to be approached with temerity. Fortunately the war types of injury are rarely duplicated in civil life. We no longer need special pressure apparatus before opening the chest cavity and the collapsed lung can be brought out through the opening between the ribs and handled like a loop of intestine. The parallel is so apt that one French surgeon refers to the procedure as "laparotomizing" the chest. In empyema we have learned that repeated aspirations, with or without the injections of ether, will often effect cure instead of rib resection. We also know that early operation is not advisable in certain cases and that the main operative indication is the *pressure* from and not the *presence* of the effusion. After rib resection we treat the cavity on the theory that chemical sterilization will diminish the secretion and when this is accomplished and no streptococci are present, we close the wound by secondary suture and cut short what is ordinarily a very prolonged convalescence.

In *abdominal surgery* no particular changes are to be noted. The cases of abdominal war wounds that reached the hospitals were unfortunately often dying from shock, hemorrhage or peritonitis.

Plastic surgery has had ample scope and many of the deformities from war wounds are of course more or less equalled in civil life and can be subjected to the same kind of advanced treatment of which no special mention need be made.

Burns of the primary degrees are benefited by the various paraffine dressings with which you are all familiar and of which I need say nothing further.

The main lessons of war surgery to be carried over into industrial surgery are connected with

a. Wounds of the soft parts.
b. Fractures.
c. Joint injuries.
d. Thoracic injuries.

a. In recent *wounds*, we can improve our results by mechanical sterilization in all associated with bruising, fraying or devitalization of the edges. In those already infected, intensive chemical sterilization will do much to reduce infection leading to the stage where secondary closure can be made, thus diminishing the period of prolonged cicatrization.

b. In *compound fractures* we can treat the wound by mechanical sterilization, suture it promptly and convert the case into a simple fracture. *Simple fractures* of the long bones are effectively treated by the army type of splints, that is by the Thomas or Jones variety of splints. For femur fractures, the calipers will be found efficient. For some thigh and many leg fractures, the stirrup will give excellent results. We must not forget to regard a fracture as essentially a lacerated wound of bone and with that conception of the lesion seek to coapt the fragments so that primary and not secondary union may be attained. To carry out the analogy the splint can be regarded as a suture, and like the latter, is to be removed when it has served its purpose. Regarding a broken bone in this fashion will lead us to a more rational form of treatment so that our attention will be directed quite as much to restoration of function as to attainment of union. If we will look upon traumatic osteomyelitis not as a special disease but only as an infected wound of bone we will alter our treatment so that we will proceed to sterilize chemically the infected area, and when this is accomplished, we will remove the slough or scar in the bone, fill in the cavity by muscle or fascia or both, and then close by secondary suture. It will be quite useless to try to sterilize an infected area of bone unless adequate exposure is afforded, and hence in many cases liberal incision and drainage will be the first object of our attack. This conception of osteomyelitis means that we will no longer wait for a sequestrum (literally a bone slough) to separate spontaneously, but we will by adequate exposure open the area for the contact of our antiseptic. Dakin's solution acts especially well in bone infection, applied by the Carrel technic or by wet gauze tapes snugly placed into the recesses of the cavity, replacing them each 24-48 hours. This last method was first called to my attention by my friend, Lt. Col. George Hawley, who has had much experience with it.

c. *Joint injuries* in future will be better treated by early mobilization applying the principles of mechanical and chemical sterilization. Rigid and prolonged splintage in joint injuries is no longer to be advised, and the ordinary accident of industry affecting an articulation will profit by this new form of management.

d. *Thoracic injuries* will profit also, notably in the treatment of empyema and the removal of foreign bodies from the chest cavity. It appears to have been conclusively demonstrated that of all the tissues the lung has the greatest resistance to ordinary infection, doubtless because of the vascularity and oxygenation, and for this reason early attack may be postponed with greater safety than in any other cavity of the body.

Very little that is absolutely new has come out of the war experience, inasmuch as the principles of surgery are well standardized; the wider application of these principles under diverse and adverse conditions has, however, focused our attention on many problems that are met with in civil traumatic surgery. It is interesting to note that the same methods of wound treatment used in this war were also recommended as long ago as the Napoleonic wars by the famous French surgeon, Larrey. Indeed, Louvard (with whom I was associated for a time in France) has shown in his recent article in *Presse médicale* that many modern ideas revert to the time of Hippocrates.

BOOK REVIEWS

Vital Statistics: An Introduction to the Science of Demography. By George Chandler Whipple, Professor of Sanitary Engineering in Harvard University, Member of the Public Health Council, Massachusetts State Department of Health. First edition. Pp. 517, with illustrations. New York: John Wiley & Sons, 1919.

Vital statistics is the bookkeeping of humanity, but there are few good bookkeepers. There are still fewer expert accountants who understand the mathematics and mechanics of statistics. The ability to use vital statistics in public health work is an important part of the training of the modern health officer. Professor Whipple has done a real service by writing a clear, concise book on vital statistics as an introduction to the science of demography. Broadly speaking, demography is the statistical study of human life. Students of every branch of hygiene and sanitation owe a debt to Professor Whipple for the plain, accurate and lucid treatment of the subject. Even those who have a dislike for arithmetic will find the subject made easy and convincing.

The book makes no claim to be an exhaustive treatise or a compendium of facts; it is merely a guide to the study of vital statistics, an introduction to the great world-wide science of demography—a science yet in the magmatic stage, not yet crystallized. The Great War is bound to develop this science, because hereafter all the nations of the earth must know each other better, and this knowledge, in order to be usable, must be condensed into statistical form.

Specifically the book tells what statistics are and what they are not; it shows how to express vital facts by figures, how to tabulate them, and how to display them by diagrams; it shows how to compute birth-rates and death-rates and how to analyze a death-rate; it shows how to adjust and standardize death-rates and how to make life tables; it emphasizes the need of using vital statistics with truth, with imagination and with power. For the convenience of school instruction, exercises and questions to incite further study are given in each chapter.

The chapters deal with: Statistical arithmetic; statistical graphics; enumeration and registration; population; general death-rates, birth-rates, marriage rates; specific death-rates; causes of death; analysis of death-rates; statistics of particular diseases; studies of deaths by age periods; probability; correlation; life tables; and a commencement chapter.

The method of preparing graphs will be found particularly useful for those who have the difficult task of interpreting vital statistics to lay and professional audiences. This section should be carefully studied by the makers of health reports and also by public health educators. There is no group of observers whose opportunities for collection of valuable statistical material equal that of the industrial physician and it is fair to say that the deficiencies in their training make them unequal to the proper handling of the facts in their possession. Realizing this truth, educators are including thorough courses in vital statistics both in the curricula for health officers and for industrial physicians. To the latter group this book of fundamental principles will be found extremely valuable.

The publishers deserve a special word of commendation for the sensible example of the bookmaker's art, for it is evident that they have given careful thought to the way in which they have made Professor Whipple's book on *Vital Statistics*. The convenient size, the flexible cover, as well as the print and paper deserve favorable commendation. The volume is well illustrated and has a good index.

The book is dedicated to "The Students of Vital Statistics in the School of Public Health of Harvard University and the Massachusetts Institute of Technology."

Vital Statistics is timely and will be useful to students and practitioners of all phases of the art of sanitation and the science of hygiene. It is indispensable for health officers and will be found useful for sanitary engineers, nurses, social service workers, and medical students.—*Milton J Rosenau.*

How to Prevent Sickness. By G. L. Howe, Medical Director, Eastman Kodak Company. Pp. 203, with illustrations. New York: Harper & Brothers, 1918.

This is a well written and well illustrated book of popular type which should find a place in many factory libraries. The representations in regard to scientific medicine are clear and accurate.

The industrial physician desiring to formulate a campaign in health education in his plant will find in this manual a valuable supply of illustrations, tables, and text which it is a pleasure to recommend.—*Katherine R. Drinker.*

What We Eat and What Happens to It. The Results of the First Direct Method Ever Designed to Follow the Actual Digestion of Food in the Human Stomach. By Philip B. Hawk, Ph.D., Professor of Physiological Chemistry of the Jefferson Medical College of Philadelphia. Cloth. Pp. 232. New York: Harper & Brothers, 1919.

This is a collection of popular articles reprinted from magazines. They have a laboratory basis in very numerous observations made upon volunteers who submitted to the passage of the stomach tube for the withdrawal of test meals. The chief criterion of digestion is assumed to be time required for the disappearance of various foods from the stomach. This is rather an inadequate standard but it is still a matter of interest. The discussion is chatty and entertaining. The book contains few prohibitions and is generally cheerful and reassuring reading.—*Percy G. Stiles.*

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Healthful Schools, How to Build, Equip, and Maintain Them. By May Ayres, Jesse F. Williams, A.B., M.D., Professor of Hygiene and Physical Education, University of Cincinnati, and Thomas D. Wood, A.M., M.D., Professor of Physical Education, Teachers College, Columbia University. Cloth. Pp. 292, with illustrations. Boston: Houghton Mifflin Company, 1918.

Effects of the War upon Insurance, with Special Reference to the Substitution of Insurance for Pensions. By William F. Gephart, Professor of Economics, Washington University, St. Louis. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 6, edited by David Kinley, Professor of Political Economy, University of Illinois, Member of Committee of Research of the Endowment. Paper. Pp. 302. New York: Oxford University Press, 1918.

Effects of the Great War upon Agriculture in the United States and Great Britain. By Benjamin H. Hibbard, Professor of Agricultural Economics, University of Wisconsin. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 11, edited by David Kinley, Professor of Political Economy, University of Illinois, Member of Committee of Research of the Endowment. Paper. Pp. 232. New York: Oxford University Press, 1919.

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FACTORY INSPECTION AND FACTORY INSPECTORS *

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1. FACTORY INSPECTION IN THE UNITED STATES AND ABROAD

THE purpose of labor legislation is the protection of the working population. This protection was necessary, especially at the beginning of the present economic era, because of the economic pressure and the inability of the working class to protect itself. The protection given began with regulation and restriction of child and female labor, and gradually extended until it embraced economic, sanitary and health phases and conditions of labor. The extent of protection given to the workers by the labor laws promulgated did not, however, and does not depend upon the *number* of these laws or the extent of labor legislation. The real protection given to workers depends solely upon those laws which are actually enforced, and the real value of labor legislation depends only upon the extent of its realization and proper enforcement.

There is no greater danger to the social fabric than empty parliamentary promises, or labor laws dead upon the statute books. The non-enforcement of labor laws breeds discontent and fosters anarchy. It makes law seem a mockery, protective legislation, a snare and delusion. It creates resentment. It forces the labor population to lose all hopes for protection from the state and community. It compels it to seek more forcible means of self-protection.

The enforcement of labor laws presupposes the setting up of a machinery for the purpose. Such machinery consists in the organization of so-called labor departments and factory inspection bureaus. Factory inspection has always lagged behind labor legislation. The advocates of protective legislation and the proponents of labor laws, as a rule, at first ignored the necessity of creating special bureaus for factory inspection. Only after time had shown that the mere enactment of labor laws was insufficient to give proper protection to the workers, was it possible to persuade legislatures to make special provision for enforcement of these laws.

The beginning of factory legislation in England dates back to the year, 1802, when the first known labor law was promulgated, but it was not until 1833 that the first attempt was made to establish a factory inspection department. In France there were labor laws issued during the first three-quarters of the nineteenth century, but no labor inspection department was established before 1874. The same applies to Prussia, Austria and other European countries.

Factory inspection in the United States likewise lagged behind factory legislation and years elapsed before it dawned upon legislators that not only factory laws but provisions for their administration were needed. Although a number of labor laws aiming at child and woman labor protection were issued by the legislatures of various states all through the middle of the nineteenth century, it was only in 1886 that Massachusetts attempted to es-

*Received for publication June 5, 1919.

tablish factory inspection, and in the same year a factory inspection bureau was established in the state of New York, followed by Pennsylvania in 1889 and Illinois in 1891. In Wisconsin, factory inspectors were appointed in 1887 and in New Jersey, theoretically in 1883 but actually in 1889.

Sponsored by social workers and philanthropists, advocated by far-seeking statesmen, and, at first, but feebly supported by the labor elements themselves, labor protective laws invariably met a bitter and strenuous opposition on the part of organized and unorganized employers. Strong, however, as the opposition was against the enactment of protective labor laws, still stronger was the opposition to the creation of machinery for the enforcing of labor laws. To this united and strong opposition of employers against factory inspection was due the lagging of legislation for factory inspection in many of the countries abroad and in the states in this country. The same forces assisted in rendering the newly created machinery for labor enforcement but feeble bulwarks against the power of factory owners and employers.

The value of factory inspection and the extent of protection given by factory inspection departments naturally depend upon the organization of the machinery for enforcement, upon the scope and functions given to the department, its powers, rights and duties, the proper appointment of its higher personnel and the selection and appointment of the rank and file of the inspectors.

From the beginning of the creation of factory inspection departments, they suffered much and still suffer from lack of proper organization, inadequate conception of the scope and functions, insufficient powers and inadequate rights, bad selection of the higher personnel and an inadequate and insufficient selection and training of the rank and file of inspectors. In a report on "The Efficiency of Factory Inspection Machinery in the United States" (1), the inefficiency of the factory inspection machinery in the United States is stated in a nutshell as follows: "The most dangerously unguarded machinery I have known is the machinery of factory inspection in the United States, exposed to a most pernicious political influence and to the parsimony of legislators, rendering possible the industrial diseases and accidents which a provident nation would promptly make impossible. In twenty states the head of the labor department is designated by the governor and his term of office depends usually on the political fortunes of his chief. The absence of a permanent character in this important post makes it possible for politics to play no uncertain game, both in the choice and in the character of the man who is sworn to enforce the labor laws. To my mind no state, except possibly Massachusetts and Wisconsin, has entirely freed its labor department from a destructive political influence. In Pennsylvania I found that many of the factory inspectors were conducting private business enterprises while holding commissions in the department. One is alleged to have sold fire insurance. Another kept a saloon. Still another was in the coal business. In another state, where the chief factory inspector divides his time between conducting a livery stable he owns and the business of caring for some 30,000 factory wage-earners, I found him contributing a remarkably concise annual report consisting of exactly fourteen words. It reads, under date of July 1, 1911, as follows: 'I have visited the same factories as last year and find conditions the same.'"

The report of the investigations made by the National Civic Federation in 1910, the reports made by the American Association for Labor Legislation and the reports of the factory inspection departments themselves, all tend to prove the same—the insufficient power and rights accorded these departments, the inefficiency of the organization, the narrowness of their scope and functions, the improper selection of the heads and chiefs of departments and bureaus, and the low status of the rank and file of the inspectors.

It is needless to state that these fundamental defects in factory inspection are bound to affect deleteriously the enforcement of labor and factory laws in the country, to nullify the extent of protection intended to be rendered by these laws, and to create disregard and contempt of factory inspection alike among workers and employers. The workers, organized and unorganized, feel the inadequacy of protection given to them by the many de-

partments and bureaus created for that purpose. They know that many of the labor and factory commissioners have inadequate power, even if they have the will to enforce labor laws. They know that the average labor commissioner and chief factory inspector is a legal appointee, subservient to the political powers that be and but seeking to keep his position during the temporary political hold of his party. They know that an annual, single, cursory inspection of the factory where they work is of very little avail if not conscientiously followed up. They also know the incompetency of the average factory inspector, his lack of knowledge and experience and the absence of zeal and enthusiasm for his work.

The employer, on his part, regards factory inspection with suspicion and treats factory inspectors with contempt. In an experience of twenty-five years I have found few employers who give due respect to factory inspectors. During my directorship of the investigations of the New York State Factory Commission in 1911 and 1912, I have been told over and over again by a large number of factory owners that they cannot trust the average factory inspector, and, as a rule, they disregard his criticisms and recommendations. "Who is the average factory inspector anyway and what does he know?" were the usual queries. "As a rule, he has no knowledge whatever. He is an absolute ignoramus. He cannot distinguish a belt shifter from a steam pipe. He knows nothing about machinery. He has no conception of the needs of the particular establishment which he is supposed to inspect. His criticisms are often foolish and his recommendations ridiculous."

Indeed, the average factory inspector is rather an inefficient official. He has seldom graduated from high school. He owes his appointment to political preferment or to an inadequate and inefficient civil service selection. He has had no training for his work. He lacks technical knowledge and does not possess mechanical abilities. He regards his position as temporary. He changes it as soon as he finds something better. He has no faith in his own work; no understanding of its scope and functions. He has no hopes for promotion, no outlook for the future. He receives few commendations for work well done. He is often criticized for treading upon the toes of politically powerful employers.

In the summer of 1913, I had the privilege, as representative of the U. S. Department of Labor, of making a study of factory inspection in six European countries (2). It may perhaps be pertinent in this place to state that the results of my studies clearly proved that factory inspection abroad is much more efficient and adequate than in this country and that the rank and file of European factory inspectors are far above the rank and file of our own inspectors; that the superiority of European inspection over that of the United States lies almost solely in "the higher grade and character of the inspectorial force"; that Europe is, in this respect, far in advance of the United States; and that we have no such factory inspectors as a class. Here and there in one state or another there may be found one or more examples of efficient and trained factory inspectors, but these are isolated cases.

The reasons for the superiority of factory inspectors abroad have been summarized in that report as follows: (1) Factory inspection in Europe is a profession and a vocation and is regarded as a life work; (2) factory inspectors in Europe must come through a long preliminary preparation, must have a scientific education and technical training; (3) merit, length of service and competence are the only basis for promotion from one grade to another; (4) superiors, chiefs and heads of the service are promoted from the ranks only for merit, experience, length of service and competence; (5) tenure of office is secure; promotion certain; treatment liberal, and a pension given for long service and old age.

Much remains to be done if the purpose of labor legislation is to be fulfilled, if real and adequate protection is to be accorded to the labor population. The foremost task, however, is to insure the recognition of the need of reorganizing factory inspection in this country and the recognition of the new tendencies and principles of labor legislation and the new necessary methods of factory inspection. It is imperative to raise the status of the factory inspector and to put factory inspection on a higher plane. There is likewise absolute need of a radical change in

the methods of selection of factory inspectors and in the creation of facilities for the proper training of factory inspectors in this country.

I shall discuss the subject in the following sub-divisions: (1) New Principles and Tendencies of Labor Legislation and New Methods of Factory Inspection; (2) The Status of the Factory Inspector; and (3) The Qualification, Selection and Training of Factory Inspectors.

II. NEW PRINCIPLES AND TENDENCIES IN LABOR LEGISLATION AND FACTORY INSPECTION

Over a hundred years old in England, much less in other European countries, and hardly two or three score years old in the United States, labor legislation has made giant strides and has achieved phemonenal progress during these years. From the simple enactment of the "Apprentice Law" of 1802, scarcely a few pages long, labor laws have been augmented, increased and multiplied until now, in most of the countries, they fill large volumes and constitute a formidable code. From the simple regulation and restriction of certain phases of child labor, labor legislation has progressed until it practically embraces every phase of working conditions; regulating, restricting, prohibiting and otherwise guiding all labor and its processes; protecting the workers; regulating hours of labor; prescribing the form, manner and minimum of wage payments; improving the sanitary and other conditions in industrial establishments; providing standards for mechanical equipment; supervising processes of work; and promoting the health and preserving the lives of the workers in workshop, factory, mine and quarry.

This progress, great and remarkable as it is, has been achieved by a slow and, at times, painful process. It has been achieved in spite of opposition and in the face of the indifference and negligence on the part of the workers themselves. Only gradually, as the workers through their organization became convinced and conscious of their power, and when the employers themselves came to the conclusion that it does not pay to neglect the human factor in industry and that industrial productivity and efficiency are increased with the improvement of labor conditions—only then did it become possible to induce legislators to pass those salutary laws which are at present on the statutes of every labor code in every civilized country.

It is unfortunate that in this progress of labor legislation, labor law enforcement and factory inspection have not kept pace. While labor legislation has continued to include new phases of working conditions, while the simple regulations, restrictions and prohibitions of child and female labor have gradually given place to exhaustive and far-reaching measures to prevent industrial accidents and occupational diseases, the machinery for enforcement of these laws has remained based upon the same old principles and has followed the same old methods which were suitable only to the primary phases of labor legislation.

Thus, when the labor law meant nothing but regulating the maximum hours of labor for children of certain ages and for women, the enforcement of these laws was a simple police measure, based upon the police power of the state, and the methods employed by the factory inspection departments were what may be called "detective." All the inspectors needed to do to enforce these simple provisions of the law was to visit industrial establishments at unexpected times and to find at work children under age, or to swoop down upon the factory after hours to discover the work of minors during these prohibited times. These *detective* methods of inspection naturally required little knowledge and experience on the part of the inspector, an official of rather low status, a person with the qualities of a police dedetective rather than one with a high education, knowledge and general industrial experience.

A prominent labor leader, a former chief of a factory inspection department in a great state, once, in a lecture on factory inspection, stated that "the value of a factory inspection department and the measure of success achieved by factory inspectors may be determined by the number of prosecutions instituted and won for infringement of the labor law." This is tantamount to saying that the efficiency of a police officer is determined by the number of arrests he makes and by the number of thieves found in his district, and the

value of a teacher is determined by the number of grammatical and other mistakes made by his pupils. Such thorough misconception of the important functions of factory inspection is explained only by the fact that this labor authority considered labor laws from the view of enforcement of child labor laws only, and hence regarded as the most valuable factory inspector the one who succeeded in spying out the largest number of violations of the child labor law and in successfully bringing the culprits to justice.

Factory inspection, its principles and methods, must necessarily change with the new tendencies of labor legislation. The basis of labor laws at present is not the simple restriction of child and woman labor, important as this is, but the prevention of industrial accidents and occupational diseases; measures of fire protection, of safety, of proper factory construction; arrangements for light, ventilation and sanitation; the regulation of industry to prevent occupational diseases and to preserve the life and promote the health of the workers—all of which demand a change in the principles, methods and procedure of labor law enforcement and factory inspection. Detective methods of inspection must give place to preventive work on the part of the inspectors.

These changes must necessarily react upon the status and character of the factory inspectors themselves. Detective inspection may be performed by ignorant and inexperienced men. Not so with preventive inspection. To note defects in construction, to detect inadequate fire protection, to realize the inadequacy of unguarded machinery, to test the amount of light and character of ventilation, and to propose proper means for prevention of accidents and occupational diseases, a new and different character of inspection, as well as a new type of inspector, is required. Wide experience in industrial fields, great technical knowledge, mechanical ability, considerable hygienic erudition—all are required for the new enforcement of labor laws and for the new preventive factory inspection.

Has the organization of factory inspection departments followed the progress of new labor legislation? Have the methods of factory inspection been adjusted to the new needs and requirements? Have the factory inspectors become proficient in the new knowledge demanded from them? Are the new factory inspectors appointed of a higher class, conforming to the new principles, methods and needs of labor legislation and enforcement? Unfortunately, the answer must be in the negative as far as conditions in this country are concerned.

There is yet another and very important problem of labor legislation and administration which likewise cries for a solution. This is the growing need of specific industrial legislation. When labor laws consisted in the regulations of the age of workers, the hours and other simple conditions within the industrial establishment, the labor laws were and could be general, applied alike to all parts of the country, to all industries and establishments. This is no longer so. With the progress of labor legislation and need of more detailed industrial regulations, specific rules for certain districts, special regulations for certain industries, and detailed proscription of individual industrial processes become a necessary part of labor legislation. Moreover, special industries and individual industrial establishments may at certain times need special regulations, exemptions and exceptions. All this cannot emanate from general national or state legislatures. These law-giving bodies have neither the knowledge nor the experience to legislate for each and every industry, industrial establishment, period or occasion. It, therefore, becomes incumbent either to give to the law enforcement machinery or to the factory inspection department legislative power to make rules and regulations, to grant exemptions and exceptions, or to create a separate body attached to each factory inspection department for these purposes and functions.

This problem has been solved variously in different countries and in different states. England has empowered the Home Secretary to issue special rules and regulations and give exemptions and exceptions, not, however, without certain restrictions requiring public hearings and the co-operation of employers and workers. The Home Secretary, therefore, becomes an ancillary legislative power with wide administrative duties and rights.

Germany and Austria attempted to solve this problem by an entirely different method: (1) by making the labor law very general, leaving its interpretation and application to the factory inspectors, and (2) by requiring a large number of industries and industrial processes to be specially licensed. The gist of Article 120 of the Industrial Code of the North German Union as well as of Article 74 of the Industrial Code of Austria contained the following general provision:— "Employers are to establish and to maintain their establishments, workrooms, machines and utensils so as to protect workers as far as the nature of the industry permits against the dangers of injuries to life and health. They are also to provide such devices as are necessary for the protection of the workers against dangerous machinery or against any other dangers to health and life." These paragraphs, giving but the fundamental principles of labor protection, are the basis of the various rules and requirements which are made by factory inspectors in each district of the country and which are intended to adjust the methods of protection to each industry, industrial establishment and period of work.

On the other hand, the licensing of a very large number of industries, especially those where there are certain dangers to limb, health and life, and the rigid rules and regulations required for the new construction of these establishments, for new equipment and installations, gradually render the more important and more dangerous industries and establishments more and more safe for their processes and their workers.

In the United States, the need of special rules and regulations to be applied to certain parts of the country and to certain industries has led to important changes in the constitutions of labor departments and factory inspection bureaus. The first change was in the adoption of the so-called, "Wisconsin idea," the creation of the Wisconsin Industrial Commission with the general mandate to "take charge of the safety of the workers," leaving the definition of "safety" to the commission and permitting it to "make such rules and regulations and adopt such provisions and standards as, after proper investigation, it may deem fit." After the work of the New York State Factory Commission in 1911-1913, New York State established an Industrial Board, composed of several persons, with the sole legislative function of providing special rules and regulations and giving of exemptions and exceptions to special trades and establishments. This, however, was shown to be unsatisfactory, and later New York State, soon followed by Massachusetts, Pennsylvania, New Jersey, Illinois and other states, reorganized its machinery for enforcement of labor laws and changed its single-headed labor department and factory inspection bureau into an industrial commission with several members, giving this commission not only executive but also legislative and judicial rights and powers.

As has been stated above, the new and comprehensive labor legislation and the need of preventive inspection required a higher status of the enforcing personnel and a change in the character of the factory inspectors. This problem has also been solved differently in different countries and states.

Factory inspection in England began with a high conception of the importance of the functions of the factory inspectors. The first four factory inspectors appointed in England in 1833 were men of high calibre, scientific attainments, social standing, industrial knowledge and experience, and, incidentally, highly compensated.* It is fortunate that England selected inspectors of such high calibre, otherwise factory inspection might have proved a failure in that country and its progress much retarded in other countries as well. It is due to the high character of its first factory inspectors that England succeeded in compelling employers to respect them, in proving to workers the impartiality of factory inspection, and in compelling legislators to listen to the advice of these recognized and respected experts. The character and status of factory inspectors in England has never been lowered. There factory inspection has become a highly specialized profession, where specialists—medical, engineering, etc.—have been called to take charge of certain special phases of factory inspection. At the same

*The salaries of the first factory inspectors in 1833-34 were 1000 pounds, about $5,000, equivalent now to $10,000 or $12,000

time England has not neglected the enforcement of the restrictive and prohibitive child, woman and workshop regulations, having created a separate force of *assistant inspectors* to take charge of this work, requiring detective inspection and lesser qualifications.

Germany and Austria have again followed their own peculiar methods of solving the same problem. In these countries there is hardly any specialization but, on the one hand, detective inspection and the enforcement of child and female labor laws and minor restrictions have been entirely taken away from the factory inspection departments and concentrated in the local police authorities, who have sole charge of the enforcement of restrictive and prohibitive labor regulations and of all factory violation prosecutions. On the other hand, by a special method of selection and by a highly developed method of training, the factory inspectors of Germany and Austria are so highly educated in industrial hygiene and have become so expert in industrial matters, that they are well able to take care of all the phases of enforcement of preventive factory inspection and are fully competent to serve as the final arbiters in matters of licensing especially dangerous industries and establishments.

In the United States the process of adjusting the enforcing personnel to preventive inspection is progressing very slowly and has as yet attained comparatively little success. The appointment in 1907 of a medical factory inspector in New York State and in 1912 of two medical factory inspectors in Illinois and the establishment of industrial hygiene bureaus and divisions in New York, Wisconsin, Illinois, Massachusetts, Pennsylvania, New Jersey and other states is a result of the need of a specialized and higher class of inspectors to perform preventive functions of factory inspection. It is to be regretted, however, that in the establishment of these industrial hygiene bureaus and divisions and in the selection and appointment of their personnel, the same faulty methods have been used which, as I shall later endeavor to prove, are the main factor in the inadequacy of factory inspection, in the low status of the factory inspectors and in the inefficiency of factory inspection work in this country.

III. STATUS OF FACTORY INSPECTORS

The enforcement of labor laws depends upon the proper machinery for enforcement, and upon the adequacy, competency, efficiency and experience of the persons selected for factory inspectors. The character of factory inspectors, however, depends upon their status.

In Germany, Austria and other countries factory inspection is a profession. The factory inspector is an important official. He possesses rank similar to the state physician, the state architect, the state engineer and other state officials. He is a part of the state bureaucracy. He starts with the rank of an industrial assessor and passes through the stage of industrial inspector to that of industrial counselor, and has a chance of promotion to the highest rank attainable in the official bureaucracy. Possessing rank and knowledge, the factory inspector is highly respected by the employer with whom he comes in contact as well as by the workers. Being a highly trained official with wide experience in various industrial matters, his criticisms of industrial defects and his recommendations as to their improvement are listened to with respect and submitted to with grace by the trained superintendents, managers and foremen of industrial establishments, for these acknowledge the superior knowledge and experience of the inspector in his specific field. The tenure of office of the inspector is perfectly secure; his promotion gradual and assured. At the expiration of a stated term and in disability and old age, the inspector is assured a pension.

In Belgium the factory inspector of low rank who was assigned to accompany me through the factories was a trained technical engineer, who deliberately chose factory inspection as his career. On my inquiry he told me that this was just as liberal a profession in his country as medicine, law, etc., and that within a certain period he expected to become chief inspector. He regarded his profession as a life's work, to which he brought all his acquired knowledge and experience.

In England, while not possessing rank, the factory inspector is usually a college-bred man, a technically trained official, a man sure to inspire the respect of the factory owners and the confidence of the workers.

In this country factory inspection is not a profession. The rank of factory inspectors is recruited from a heterogeneous, nondescript class, the majority of whom have failed in some other pursuit of life. This is the case not because it is absolutely impossible to get highly qualified persons to make careers of factory inspection, but because of the low status of the factory inspector's position.

The tenure of office of the inspector is insecure. Even where he is protected by civil service regulations, the protection is more apparent than real. In those states where no civil service protection whatever is given, the tenure of office depends on the political or personal will of the chief inspector, usually himself a political appointee. Doubting the security of his tenure of office, the factory inspector has no desire to take up the subject seriously, to devote his time to the gaining of knowledge and experience in his field of work, or to regard it as his career.

To the insecure tenure of office must be added the low pay of a factory inspector. In an investigation of this subject a few years ago, the American Association for Labor Legislation made a compilation of the pay of factory inspectors in various states. It found salaries ranging from $900 to $1200 per year. In some states it was lower. This means that the factory inspector must expect to be satisfied with a weekly wage of between $18 and $23, a sum much less than the wage nowadays of an assistant plumber or carpenter. While the salaries of American factory inspectors are much higher than the salaries usually paid to factory inspectors in France, Germany, Austria and other continental countries, they are much smaller than the salary paid to the English factory inspector. The maximum salary which a factory inspector may hope to attain is $1800 and but few may attain this sum.

English as well as continental factory inspectors are assured pensions after a certain term of years in office and after disability and in old age. These pensions amount to from half to two-thirds of the salaries which they received during service. In this country there is no state that gives pensions to its factory inspectors. I have known men who have grown gray in service and who, in their old age, were discarded into the scrap-heap because they were no longer able to pursue their work. With low pay, insecure tenure of office and no assured income in old age, can one blame a man for refusing to choose factory inspection as a profession, or to stay in the work if it is possible for him to better himself?

Another cause of the low status of factory inspectors in this country is their shabby treatment in matters of promotion and selection of chiefs. The continental factory inspector knows every step of his promotion. He knows all the stages through which he must pass if he but follows the routine of his work. No superior in the factory inspection department and no head or chief is ever selected outside of the ranks and no one is promoted above the others unless for sufficient and explainable cause. The same routine of regular, sure promotion which is followed in military and bureaucratic life is also followed in the factory inspection department. There is also a continuity in the policy and work of the department due to the very few changes and to the long tenure of the heads of the departments. For nearly eighty-five years in England there were hardly half a dozen changes in the chiefs of the factory inspection department, and these mostly due to death and retirement. Compare these conditions with those in the United States. Here there is hardly a state where the tenure of office of the head of the department is longer than four years and usually it is two years. With every political upheaval and with a change in administration there is a change in the head, chief or commissioner of the department. In the thirty-odd years of the history of the New York State Factory Inspection Department, it has been ruled by a dozen or more chiefs, heads or commissioners. Scarcely is a labor commissioner or chief factory inspector appointed, hardly is he acquainted with his work, than he at once begins to expect decapitation. Under such conditions there cannot of course be any continuity of policy, any enlightened conception of functions, or an even-continued administration. Moreover, the commissioners, heads and chiefs are appointed more for their political affiliations than for their knowledge of the subject of factory inspection or their experience in similar work. Few of them enjoy the re-

spect of the rank and file of the inspectors or the confidence of the industrial population, worker or employer.

In very few states is promotion of factory inspectors from one grade to another regular, followed in due course and based upon justice. Very often when supervising or other higher class inspectors are to be appointed, the positions are filled by politicians and those who are *persona grata* to the powers that be. It is only a matter of several years since there was an earnest protest in New York State against the appointment of a janitor as supervising factory inspector, in spite of the fact that there were many inspectors among the rank and file who had earned promotion to the position by years of faithful work.

In order to improve factory inspection, we must put the status of the factory inspector on a higher plane. There must be some continuity in the higher personnel of the departments. Only qualified persons with knowledge and experience in the industrial field should be appointed as heads of departments, chiefs or commissioners, and when appointed should be kept, irrespective of political affiliations or changes. Promotion should be regular, gradual and based upon length of service and efficiency. No outsiders should be drafted into the department so long as there are persons within the department to fill the positions. The tenure of office of inspectors should be absolutely secure during good behavior; discharge only after a proper trial and with usual legal protection. Inspectors should be assured of pensions for old age and disability, which pensions should be liberal and sufficient for decent support. The pay of inspectors should be much higher. No inspector should be appointed with a salary lower than $35 per week, which should be gradually increased until it reaches at least $3500 per annum.

Only under such conditions will it be possible to raise the status of the factory inspectors in this country and to insure a proper selection and training of these useful officials so as properly to enforce labor laws and give real protection to the working population. The position of factory inspector requires no less ability and training than many public offices much more highly paid.

IV. QUALIFICATIONS, SELECTION AND TRAINING OF FACTORY INSPECTORS

Factory inspectors should possess the highest possible qualifications. They should be recruited from the most intelligent classes of the community. He who wishes to devote himself to the profession of factory inspection should be endowed with a good physique and robust health. He should have a gentlemanly bearing and be able to meet on an equal footing employers, superintendents and managers of the plants he inspects. He should be able to command the respect of employers, to gain the confidence of the employees and to earn the respect and confidence of the community. The factory inspector should have a good general education so as to enable him to stand on a basis of equality with the average employer and superintendent. He should have a prolonged training and experience in industrial work and should possess the practical knowledge of industrial conditions so necessary for intelligent inspection of factories and workshops. The inspector should go through special technical training in factory architecture, in the theory and practice of factory fire protection, lighting, ventilation and sanitation. A technical knowledge of machinery is necessary in order to enable him to inspect all kinds of machinery, to note absence of safeguards and to suggest improvements. The factory inspector also needs a thorough preparation and training in matters of industrial hygiene in order to be cognizant of the conditions leading to the deterioration of health of workers, and be able to promote industrial hygiene and sanitation. The inspector should also have a general knowledge of the various kinds of dust, their effects and methods of prevention; should know the different industrial poisons, their specific effects and means of prevention. Whenever possible an inspector should be able to speak the languages which the working population in his district use, should be able to make the technical tests for air, light and ventilation and should also have the ability to give talks and lectures to classes of workers and at educational institutions.

How far the average factory inspector in this country falls short of the above requirements I need not here add. Selection for fitness is still a rare method of ap-

pointment of factory inspectors in the states. Labor laws and factory inspection departments have been won from reluctant legislators by the efforts of partisan politicians and political labor unions, and when these laws were enacted and inspection departments established, the spoils usually went to the victorious politicians without regard to the necessary qualifications of the personnel.

In the report of the National Civic Federation, already referred to, the statement is made that in nearly every state reported no examination is required for appointment as inspector. There were a few exceptions among the states where the returns stated that a civil service examination is required. The report further adds that "the inference is that there is generally a prevailing defect in statutes which leaves the determination of what the statutory requirements as to inspection may be to personal or political interests."

In the report of the American Association for Labor Legislation, also already referred to, it is stated that only in Massachusetts, Minnesota, New Jersey, New York, Ohio, Wisconsin, Colorado and Illinois were inspectors under civil service. In the other states inspectors are either political appointees or are merely required to have had some practical experience, such as having worked in a shop, the other qualifications for inspection being determined solely by the appointive power.

No special technical training diplomas or educational qualifications are required from candidates for factory inspectors even in those states where civil service examinations have already been established on a firm basis. The character of the questions given in the various examinations is such that a person with no experience and with a little instruction may be able to cram the necessary knowledge within a few weeks and to pass a satisfactory examination.

The usual civil service requirements for experience are that the candidate shall have worked several years in an industrial establishment, which, of course, is no criterion of his education or technical knowledge needed for factory inspection. The questions usually propounded in the civil service examinations for factory inspector have mostly to do with the labor law and the industrial code, which may be learned by heart by anyone.

In contrast with the conditions prevailing in the United States, it will perhaps be interesting to describe briefly the methods of selection and examination of factory inspectors in several European countries. In all European countries the personality of the candidate plays a most important rôle, apart from any scientific education, technical training and other requirements imposed. The appointive powers in all countries select only those who have passed certain tests and examinations and also determine who shall take those tests. A system of nomination and appointment serves to exclude undesirable candidates, even those of superior education and technical training. Prussia and most Germanic states demand very high technical training while England only requires a certain number of inspectors to be technically trained men, the others being recruited from those possessing a high educational status. In France the inspectors are not all technically trained men although the examinations are more technical than in England and the technical branches form the most important part in the competitive examinations. In Austria, most of the inspectors are technicians, chemists, electrical or mechanical engineers. The countries which give most rigid examinations and tests are England, France and Prussia.

England.—In England only those candidates who make a formal application to the Private Secretary of the Home Office in London are considered, and only those who appear, after careful consideration and inquiry, to be the best qualified in every way for the position are given the opportunity to compete. Candidates are given one month's notice of examination. The age limit is between twenty-two and thirty, but may be extended to thirty-eight in case of persons having occupied positions of manager, foreman, etc., in engineering works. The candidate must pay a fee of 3 pounds (about $15) for the examination.

The subjects for examination are: Obligatory, English composition and arithmetic; and the following optional subjects of which four must be offered: English history; English literature; general modern history; French, German or

Italian; mathematics; economics, including knowledge of the history of industry; chemistry; physics, including mechanics, practical mechanics and industrial machinery.

The examination lasts about five days from 10 a. m. to 5 p. m., with an interval for lunch. The examination is written and oral. Oral tests are given in French, advanced mechanics, chemistry, and physics. The general appearance of the candidates is also rated.

France.—The age limit for applicants for the position of factory inspector in France is twenty-six to thirty-five, with no exceptions. Candidates must undergo a physical examination, must bring certificates of good character, etc.

The examination proper consists in: (1) A composition on labor laws wherein the candidate must show knowledge of all the labor laws and rules and regulations of the factory inspection department and also show acquaintance with the administrative and penal law and the forms of protocols, etc., used by inspectors; (2) questions relating to air and ventilation, heating, lighting, plumbing, water supply; dust dangers and removal, gases, fumes and poisons, infectious materials; labor; and extreme temperatures, humidity, compressed air, electrical plants, etc.; (3) technical examination in electricity, mechanics, labor machines and accident prevention; (4) knowledge of mathematics, algebra, geometry and trigonometry.

All tests must be finished in one day. Three hours are given for the compositions on law and one and a half hours for the other compositions. The oral tests are given about four weeks after the written examinations to those only who have passed the first tests.

Besides the oral tests a special practical test is also given. The first relates to industrial hygiene and applied mechanics and is given in the National Conservatory of Arts and Trades. Here each candidate is placed before an apparatus. He must describe the different means of ventilation, the drawing off of smoke, gases and vapors; explain the working of motors, machines, tools; and suggest provisions against accidents. Practical examination is also given in the laboratory, testing the candidates' knowledge of the use of various instruments, anemometers, hygrometers, psychrometers, the analysis of potable water, air, dust, etc.

Prussia.—Prussia is the most severe in its requirements for candidates for factory inspector. Prussia demands from a factory inspector the following: (1) A certificate of graduation of nine classes of gymnasium; (2) three years' technical study in a German high school; (3) one and a half years' study of law and political science. These are the preliminary requirements. Candidates passing these are then subject to two examinations and a period of probationary work in the industrial inspection department. The two examinations are respectively at the beginning and at the end of the probationary service. The first examination may not be required if the candidate has the qualifications of a state machinery construction master, a mining, technical or chemical engineer. The main examination is oral and written and is conducted by a board of supervising officials in Berlin, especially appointed for the purpose. The questions relate to administration of the industrial code and political science and to administration. *The candidate is given six weeks' time in which to answer the questions, which period may be extended to two months.* The oral examination consists of questions which tend to show the ability to determine and solve technical problems of practical service. The examination determines the knowledge of the candidate of the constitution of the German empire, Prussian state, state administration, industrial code, etc. It also goes into the understanding of the methods of safeguarding machinery, principles of construction of factories, methods of heating, ventilation and sanitation. The candidate is required to have a knowledge of prevention of accidents, prevention of dangers to health in industries and the danger of certain industries to neighborhoods; likewise a thorough knowledge of the Industrial Code and the Workmen's Insurance Code is required. A fee of 50 marks is charged for the examination.

After passing his first oral and written examination the candidate is appointed for probationary service, is considered an industrial referendum, and is put under the immediate supervision of an industrial assessor inspector, who acts as his pre-

ceptor and under whose direction the candidate pursues his work. *The service lasts one and a half years.* It consists, first, in clerical work and learning of all the industrial bookkeeping, etc., used in factory inspection offices, which training is then followed by the candidate accompanying the inspector on his tour of factory inspection. This period lasts nearly a year. During the last three months of the probationary period the candidate is required to learn the routine work of inspection in its relation to the government, preparation of reports, etc. During all this probationary period the candidate receives no salary.

At the end of the probationary period the candidate is required to write a thesis to show his knowledge of industrial hygiene and sanitation and his ability to solve problems arising in factory inspection.

It is not here advocated that we, here in the United States, should adopt the same rigid requirements which have proved so satisfactory in European countries. Nevertheless, there is a distinct need of undertaking definite measures to supply the necessary knowledge and technical training to candidates for service in factory inspection departments before their selection for these positions. There may also be need to continue the technical training of inspectors during at least a year or more of their first period of service in such a department.

There is much reason for advocating the introduction of a special course for the training of factory inspectors in the high schools, in colleges, and especially in technical schools and engineering departments of universities. The provision of facilities for special study for those desiring to enter the profession of factory inspection would redound to the benefit of the cities and states in which they were introduced, would raise the status of factory inspectors and would tend to fill the ranks of factory inspectors with highly qualified and specially trained inspectors.

As far as I know there are no state labor departments and factory inspection bureaus that attempt to give a technical training to newly appointed factory inspectors. In New York State an attempt was once made by the Labor Department to give a few lectures to the factory inspectors, but this has seemingly been abandoned. There are sufficiently trained men in and out of the factory department who could give the needed instruction to new candidates and there is abundant material in these departments to teach the new inspectors the methods of factory inspection and the knowledge of various specialties in industrial hygiene and sanitation.

In concluding this paper it may be of interest to state that a course in industrial sanitation is to be given by the writer of this article during the first semester of the 1920 course of the New York School of Social Workers. This course succeeds two previous courses given by him on the same subject in the Extension Department of the New York City College during the years 1917 and 1918.

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HERNIA IN INDUSTRY *

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DATA on the physical examination of prospective employees reveal the fact that approximately 3 per cent. of the men offering their services to the industries have well developed inguinal hernias; approximately 14 per cent. have incipient hernias. Hernia occurs with sufficient frequency to be regarded as the greatest single frailty of the American worker. The oblique inguinal type comprises over 92 per cent. of all hernias encountered.

THE EMPTY HERNIAL SAC

The preliminary physical examination sometimes fails to disclose the presence of an existing hernial sac. A hernia is a protrusion, the essential part of which is the hernial sac. The lining membrane of the body cavity is the peritoneum, and the hernial sac is a process of peritoneum shoved out from the body cavity, serving as a pocket for the reception of portions of omentum, intestine, or other abdominal organs. The hernial sac, serving as a receptacle for hernial contents, may remain empty for years. The palpating finger of the examining surgeon can not feel the empty hernial sac. When the sac fills, however, the examining surgeon readily feels the fluid or solid contents which distend the sac. Fluid serves as a hydrostatic dilator of the pre-existing sac, until it is sufficiently distended for solid contents to enter.

The hernial sac which has acquired solid contents, as a rule, will spontaneously empty itself when the individual lies on his back in bed. Solid contents may not enter the hernial sac every day, and the individual may assume that the hernia has disappeared. Hernial sacs may fill and empty themselves many times, and persons afflicted with them may not have observed the hernial mass. Honest men, in perfectly good faith, having thus developed their hernias, may deny that they are suffering from hernia. Again, the individual examined may be disinclined to relate the whole truth, though he knows very well that coughing, sneezing, straining at stool, some kinds of work, may bring down his hernia; he rather gloats over the fact that he has "put something over" on the doctor, in having "gotten by" with his hernia.

While applicants with hernias are not refused industrial employment for which they are qualified, the physical examination records should include the tabulation of existing defects, such as hernia, as a guide to classification for suitable employment. There are other defects besides hernia, which an applicant for employment may advertantly or inadvertantly conceal from the examining physician. The empty sac, which sometimes fills, but which does not fill easily, is thus a source of diagnostic error, especially when the person examined willfully, or ignorantly, misleads the examiner. The surgeon, finding no mass in the sac at the moment of his examination and none appearing on exertion, merely records "relaxed ring," "hernial canal admitting one finger," or "two fingers," and considers the individual as a suspect, placing him in the "incipient" class.

The hernial canals may appear closed, and yet hernia may arise; conversely, the hernial canals may be relaxed, and no hernia develop. In short, the patulousness of the hernial canal, depending on the size of the aperture in the aponeurosis of the external oblique muscle, is incidental; the wide-open external ring, and the deficient fascial and muscular support of the inguinal canal, may, however, contribute to the rapid development of an existing hernia. Patients having tight external rings may simultaneously have relaxed internal rings; in such instances, no assistance in arriving at a correct diagnosis is obtained by palpating along the course of the cord —the palpation must be through the abdominal wall, as in the case of direct hernia. When there is a tight external ring and thick subcutaneous tissues super-

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imposed over a relaxed internal ring, the examining surgeon may fail to detect an incipient hernia at the internal ring. The predetermining cause of the acquired hernia in any event is the unrecognized empty hernial sac.

The diversity of opinion among competent physicians as to the existence, or non-existence, of a hernia usually hinges on the fact that nobody can palpate an empty hernial sac. Examine the patient to-day, he has a hernia, as the hernial contents distend the hernial sac. Give him a cathartic, let him rest up, and to-morrow you may not know on examination, and your colleague cannot definitely ascertain, which side to operate. As hernia is usually a bilateral anatomical defect, in cases where there is doubt, it is best to do a double herniotomy.

The industrial surgeon is sometimes censored for his inability to detect which applicants have, or have not, hernias; or will, or will not, develop hernias. As the empty hernial sac cannot be palpated, and as the man with an incipient hernia, when out of work, will have his hernial sac empty, no series of physical examinations can be absolutely correct on the score of hernia. Examples of diagnostic error are numerous, of which the following are typical:

"G" was operated for a left oblique inguinal hernia by a reputable surgeon, who told him he had no hernia on his right side. He recovered and returned to work, working one-half day, then developed a mass in his right groin. On operation, the right hernial sac was large, thick and had many adhesions. His bilateral hernia was a congenital defect, as proved by the findings at operation, though the patient had reached middle life before the developmental defect became manifest. Contents must enter the empty hernial sac before the definite diagnosis of hernia can be reached by the palpating finger of the surgeon.

"I" was an infant of eight months, admitted for herniotomy. The family physician had succeeded in reducing the hernia by manipulating an hour, but he forgot on which side it had appeared. No contents entered the hernial sac when the child cried, and as the inguinal canals were wide open on both sides, the operating surgeon did not know which side to operate.

"H" A letter in my possession declares that a certain patient was paid three times, by three different firms, for a right oblique inguinal hernia, under the compensation law of New York State. We are not conversant with all the facts of the case, but such a situation is a possibility, unless the radical cure by surgical operation is resorted to when the hernia first develops. A hernial sac with a narrow mouth, which is infrequently filled, offers this possibility.

"F." This patient was sent to the hospital with a bilateral hernia, large masses in both groins, almost scrotal in extent, and with the contents of the sacs easily reducible. A diagnosis of double hernia was made while the patient was at work. Two days later in the hospital, after the patient was purged and rested, he had a small hernia on the right side and no hernia on the left. On operation we found large hernial sacs on both sides—sacs thick and adherent and of congenital type. On repeated occasions we have found hernias down while men were at work, but could not confirm the diagnosis of hernia by palpation after the men had rested up, but on operation found large, thick adherent sacs, indicating that the hernias had existed a long time.

Such findings at operation have led us to consider the preformed sac a pathological entity, and to regard a hernia into a preformed sac as a disease, irrespective of the circumstances accompanying the first appearance of the mass in the groin.

The Hernial Sac Is Pathological

The hernial sac is preformed, occurring as (a) a congenital malformation, or (b) an acquired defect.

(a) The pre-existing sac is an embryonal remnant, and is consequently present for years before the advent of the hernial contents within the hernial sac. The processus vaginalis, having failed to atrophy, leaves as an anatomical defect, an empty hernial sac; the patulous processus vaginalis, constituting the preformed sac, is the pathological entity responsible for the advent of many hernias.

(b) The dimple of peritoneum at the internal ring may deepen, and extend along the perivascular spaces; or the protrusion of peritoneum may arise owing to weak fascial and deficient muscular support. (The direct inguinal hernia results from relaxed fascial support.) The acquired hernial sac arises slowly, because the peritoneum is a tough, resistant membrane, and can not be pushed out to form a sac by any single impulse. This is readily demonstrated on the cadaver; no finger is strong enough to push out the peritoneum suddenly at the internal ring. Yet nature permits the gradual stretching of the peritoneum without tearing it, as in the acquired type of hernial sacs.

MODE OF ONSET

The usual mode of onset of hernia is with backache, and discomfort in the groin, but the patient does not often see fit to stop work when the mass first appears. The hernial mass may appear now

and then for weeks, or months, before the patient reports it to a physician; the mass may even be unobserved by the patient until almost scrotal in extent, and is often first discovered by a physical examination. On the other hand, through fear of operation and for other personal reasons, its presence is often concealed by the patient, or if known may not yet have received enough solid contents to cause him concern. Less frequently, the mass causes sufficient pain to induce the patient to see a physician at once, and to necessitate his stopping work.

As is well known, water (peritoneal fluid) serves as a hydrostatic dilator of the preformed sac, until the sac is sufficiently dilated to admit solid contents. No mass appears until the later stage is reached, when solid contents enter the sac. With each increase in the solid contents of the sac, there is likely to be added pain and discomfort. In our experience, it is the aggravations of old hernias, rather than the incipient stages of recent ones, that produce discomfort and disability.

Just as a house is a house before it becomes tenanted, even so an empty hernial sac constitutes a latent hernia, before the said preformed hernial sac acquires contents. The owner of the empty hernial sac is blissfully ignorant of its presence, until the hernial sac fills, or is about to fill. When the preformed hernial sac acquires solid contents, the hernial mass leads to the discovery of the previously unrecognized hernial sac. The building of a house is gradual; acquired hernia, as encountered in the industries, is likewise a gradual process, and while its discovery may come as a surprise to the patient, it has really been a longer time on the way than he knows of.

ETIOLOGICAL FACTORS

The empty hernial sac invites hernial contents, and is the determining factor in the causation of hernia. Other predisposing and exciting factors are: (a) Deficient fascial and muscular support about the cord; and (b) Increased intra-abdominal pressure, as from respiratory diseases —coughing and sneezing; intestinal diseases—constipation and tenesmus; genitourinary diseases—stricture and vesical tenesmus; obesity, etc. Wearing a belt operates in a similar manner to increase the intra-abdominal pressure, and the consequent *vis a tergo,* which forces the hernial contents into the previously prepared hernial sac. With the hernial sac prepared for a tenant, any sudden increase in the intra-abdominal pressure, as from violent sneezing or coughing, may fill the sac.

The tendency to hernia may be accelerated by heavy work, requiring pulling, pushing or lifting; especially may persons long unaccustomed to such work, upon turning to heavy work, develop latent hernia. Hernia, however, is not an occupational disease, but a disease in the category with hemorrhoids and varicocele, arising from an anatomical defect. The worker at heavy labor develops strong muscles and tough fascia, which protect him in some measure from hernia, and is less liable to acquire the disease than the sedentary worker with flabby muscles and relaxed fascia, who sneezes, coughs, strains at stool, and occasionally does heavy work.

At most, occupation is only one of the exciting factors in the causation of hernia, the determining cause being the preformed sac. The hernial sac may fill for the first time when a worker is lifting, pushing, or pulling; the tenseness of muscular strain may coincide with the psychological moment for the filling of a preformed sac. If, however, the findings at operation reveal that the preformed sac existed, it is a pathological hernia, not a traumatic one.

TRAUMATIC HERNIA

A hernia is a protrusion; hence, there can be hernia of the brain, and of the lung, as well as of the abdominal viscera. A traumatic abdominal hernia is not confined to the hernial zones, but may arise wherever sufficient external violence is applied. In the truly traumatic hernia, the peritoneum is torn; there is no sac, the viscera came out through a fresh tear in the peritoneum. Direct injury, such as might be caused by the horn of a mad bull, or by the tongue of a wagon drawn by runaway horses, inflicting sufficient violence to the physical structures of the body, may produce a traumatic hernia at the site of the focal trauma.

Falls from high structures often cause

multiple fractures, and ruptures of internal organs, but seldom give rise to traumatic hernia. A violent squeeze, such as occurs when a railroader is caught between a moving car and a station platform, it is stated, may so increase intra-abdominal pressure, as to tear the peritoneum and cause a true traumatic hernia. So infrequent is traumatic hernia, however, that many industrial surgeons of wide experience have never encountered one.

In preparing a paper on "Hernia as an Anatomical Defect," for the Pennsylvania Conference of Physicians, in 1916, and again as Secretary of the Hernia Committee of the National Safety Council, 1917, the writer exchanged opinions with scores of noted general surgeons and leading industrial surgeons, particularly to get their viewpoint on hernia as ordinarily encountered in industry. Hernia is to be classified as a disease, in the unanimous opinion of these surgeons, except the rare cases of genuine traumatic hernia, as herein described.

We will quote but one, Dr. Charles H. Mayo, who says:

"I believe, as you do, that there is an anatomical defect in the individual who develops inguinal hernia following straining or accident—that he has a congenital protrusion of the sac along the cord. A true traumatic hernia, if inguinal, is nearly as much of a local injury as if it were produced on the abdomen in other regions. It should be accompanied by such local evidence of its occurrence as would be expected from injury of the parts."

STATUS OF EMPLOYEES WITH HERNIA

Industry, no less than the army, classifies the victim of hernia as subnormal. Without a truss, there is no assurance against the rapid increase in size of the hernia. The truss pinches, chafes the skin, and hurts the patient; but if loosely adjusted, the truss, in spite of its presence, permits the escape of the hernial contents into the sac.

The frequent failure of the truss to retain the hernia in reduction; the hernia continuing to increase in size in spite of a truss; the hernial contents distending the hernial sac and being pinched under the truss; the adhesions so often existing between the walls of the hernial sac and the hernial contents, making the wearing of a truss uncomfortable and dangerous; the sliding and slipping of a truss; and its rapid deterioration, all make a truss a temporary makeshift, applicable for a season, where operation is necessarily deferred, and a necessary evil where operation is contra-indicated, as for certain recurrent hernias.

The victim of hernia has been told about incarceration, and strangulation, but is willing to "take a chance." Through compensation enactments, the financial burden of the extra hazard is in a measure transferred from the chance-taking employee to the industry employing the individual suffering from hernia.

Hernia interferes with production. The employee with hernia can not put his native energy into the work; in lifting, pulling, and pushing, he does not do his share, but is disposed to shirk; he always wants to be placed on some easy job, where he will not have to work hard. The patient with hernia has difficulty forgetting himself in his work; his mind is off his work, and on his hernia, hence he is a more efficient worker after his hernia has been repaired.

RESPONSIBILITY FOR HERNIA

An acquired hernia is a disease. The acquired hernia is popularly confounded with true traumatic hernia to so appalling an extent that more cases of alleged traumatic hernia have been awarded compensation in Pennsylvania (exceeding 4000) than there have occurred cases of real traumatic hernia in the western hemisphere since Columbus discovered America. Other commonwealths have been as notorious in awarding compensation for acquired hernias, pathological in type, which are in no sense true traumatic hernias.

Yet when a hernia arises during industrial service, regardless of the etiology, we contend it should be relieved by truss, or repaired surgically, and the affected individual restored to industry. The practical economic problem arises—at whose expense should trusses be fitted, and herniotomies performed? The company's surgeon can do the herniotomy and radically cure the disease in less time than is wasted in legal quibbles over "who is responsible?"

How can the patient be responsible? He was unaware of the pre-existence of the hernial sac, until the filling of that hernial sac with hernial contents occurred. The general public, and some lawyer, then convince the patient that "he must have sustained some injury of the nature of a strain," and that "in consequence of said strain he developed a hernia."

How can the employing company be responsible for anatomical defects that lead to hernia? As surgeons, we are concerned in the cure of the victims of hernias, and would rather operate than argue; and because we know that the patients need relief, and the employing companies require their services, and their good will, we advise operation.

For the truly traumatic hernia, the employing industry is undoubtedly responsible under the Workman's Compensation Act, but less than one hernia in a thousand is of this type, hence, the 999 constitute a burden imposed by law on industry.

DIAGNOSIS AT OPERATION

In a *bona fide* traumatic hernia, there is hemorrhage, ecchymosis, torn structures showing the hernial contents escaping through a tear in the peritoneum. In the common, acquired hernia, the surgical dissection of the structures involved shows no torn structures, no hemorrhage, nor ecchymosis, and the hernial contents occupy a preformed hernial sac. The extent of this preformed sac, its thickness and its adhesions, offer more convincing testimony as to the anatomical defect, which is responsible for the hernia, than can be adduced from other sources. The time and manner of onset, when the patient first felt pain or noticed the mass, are, in comparison, irrelevant and immaterial.

The findings at operation are paramount in determining whether any given case of hernia is pathological, or traumatic. The operating surgeon and his immediate assistants are consequently the most competent witnesses in describing the findings in any given case. The surgical diagnosis, based on the findings at operation, we have therefore contended, should, to a greater degree, guide the referees under the Compensation Acts, as to which cases of hernia are pathological, and which are traumatic.

Straddling the Issue

Ohio, New Jersey, and certain other states, provide that the industry pay surgical expenses and compensation for a certain group of pathological hernia, in addition to paying for *bona fide* traumatic hernias. The group of pathological hernias thus imposed on industry must fulfill the following five points:

"Hernia is a disease which ordinarily develops gradually, being very rarely the result of an accident. Where there is real traumatic hernia resulting from the application of force directly to the abdominal wall, either puncturing or tearing the wall, compensation will be allowed. All other cases will be considered as either congenital or of slow development and not compensable, being a disease rather than an accidental injury; unless conclusive proof is offered that the hernia was immediately caused by such sudden effort or severe strain that, first, the descent of the hernia immediately followed the cause; second, that there was severe pain in the hernial region; third, that there was such prostration that the employee was compelled to cease work immediately; fourth, that the above facts were of such severity that the same were noticed by the claimant and communicated to the employer within twenty-four hours after the occurrence of the hernia; fifth, that there was such physical distress that the attendance of a licensed physician was required within twenty-four hours after the occurrence of the hernia. In the case of hernia, as above defined, compensation shall be paid, etc., etc."

This quotation is from the New Jersey law of 1919, and suggests the lines along which it is proposed to change the Compensation Act in Pennsylvania. Beginning at the phrase "unless conclusive proof is offered," the framers of this act straddle the question. Why require employees to frame up such a symptom complex in order to have their hernias operated? Why hold out the bait of compensation benefits for only one group of pathological hernias?

The law as amended will still enable claimants, who acquire hernias, to offer "conclusive proof," as it assumes that the filling of a preformed sac constitutes a traumatic hernia. Our contention is that the findings of the operating surgeon

should have some status before the referee. When at operation the sac is found to be preformed, and either of the congenital or acquired type, the hernia is not truly traumatic, even though the increase in its size may have occurred in a manner to satisfy the five points as adopted in certain states, and as proposed for incorporation in the compensation acts of other states. Under the changed law, the chief reliance is placed on subjective symptoms, as heretofore, instead of depending on objective signs, as revealed by the scalpel of the surgeon. With pantomime and proper staging, the "five points" could be simulated in a manner to make employers liable for almost all hernias, and is no better than the present arrangement—worse in that it puts a premium on malingering.

We suggest operation at the expense of the employer, yet omitting the payment of compensation for pathological hernias, as a measure of policy calculated to restore such workers to industry, without compromising their integrity. This arrangement would be a compromise, which would be less onerous to the employer, and abundantly fair to all employees, not alone to the limited group who allege a sudden filling of preformed hernial sacs, as advocated under the present proposal.

Repair All Hernia

Where a reasonable presumption exists that the employee's hernia has arisen in the course of his employment, our company accepts the patient's viewpoint and repairs the hernia without expense to the employee. When the patient knows that he will be cared for surgically, in any event, it is not necessary for him to frame up the "five points," as above recorded.

The established attitude of many industries toward hernia, where occupation is even a remotely contributing factor, is, thus, to repair surgically all hernias amenable to this type of treatment and to provide trusses where herniotomies are contra-indicated.

Operating practically all hernias that arise does not constitute an acceptance of liability for the payment of compensation benefits, but affords an early termination of such liability, if such liability is shown to exist, by early restoring the claimants to industry. Our contention is that the employer is quite reasonable in assuming financial responsibility for operating acquired hernias, where occupation is assumed to be a contributing factor in their development, and should not, in addition, be expected to pay compensation benefits for disability arising therefrom.

We are convinced, moreover, that performing herniotomies for pathological hernias should be regarded as a gratuity on the part of the industries, calculated to restore faithful employees to industry, and, at the same time, as a patriotic duty by which industrial workers are restored to their greatest efficiency.

THE OCCURRENCE, COURSE AND PREVENTION OF CHRONIC MANGANESE POISONING *

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THE commercial uses of manganese are many, but instances of poisoning have been collected from only three sources. This is possibly because the condition is rare and the symptoms so bizarre that the physician unacquainted with the possibility of poisoning by manganese and seeing a single isolated case, interprets the findings as an atypical instance of some more common type of nervous disease.

A partial list of the uses of manganese compounds in this country and abroad is as follows: It has been employed in the manufacture of chlorine and oxygen, in making dry batteries, in glass works for cleaning and coloring molten glass, for coloring brown and black glasses, to destroy carbon in the production of enamel, as a paint for Fayence and porcelain, for glazing, for coloring and graining soaps in aniline and alizarin factories, in various processes connected with the manufacture of glass, oil, and varnish, and finally in the making of cement and glazed brick. Certain manganese colors, such as manganese brown, an hydrated peroxide of manganese, have had extensive use. Manganese bistre and manganese violet are other examples of dyes made from this metal. In Holland and Germany manganese sulphate has occasionally been used as a fertilizer, but not very widely, the matter having been apparently in the experimental stage when the war began, and finally manganese has been extensively used as an alloy with steel and nickel.

In spite of these very varied applications of the metal, chronic poisoning is known to have occurred in only three types of employment:

1. In French workers handling manganese dioxide in the manufacture of chlorine for bleaching powder.

2. In Germans engaged in grinding manganese dioxide as a stage in commercial utilization for various purposes.

3. In mill employees in the United States who work in a dust containing manganese as oxides and silicates.

HISTORICAL SUMMARY

The history of the occurrence of chronic manganese poisoning is most interesting. Couper (1) in 1837 published a brief article recording observations on five workmen all employed in a chemical factory where they ground manganese dioxide in the manufacture of chlorine for bleaching powder. "Their skin is constantly covered with a layer of the oxide, and the air which they breathe is impregnated with a multitude of molecules of this oxide which are introduced into their lungs by respiration. In 1821 a young man apparently in good health, being employed at this work, presented symptoms of paraplegia which, becoming worse, forced him at the end of some months to stop work. After having tried without effect the medicines used in paralysis, he absented himself from the neighborhood for a year, and at the end of this time, having returned, it was evident that he had made little progress toward recovery. In the following year another workman, similarly employed in grinding manganese and apparently enjoying the best of health, fell equally ill. It not being suspected that manganese produced poisonous effects, he was permitted to work for several months, with the exception of short intervals employed in treatment. As the paralysis increased, manganese was finally suspected to be the cause and the workman moved to another region. After this time there was no augmentation of symptoms and at the end of

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six years the patient was in good health. During the height of the disease the weakness of the contractile muscles was much greater in the legs than in the arms. It was of such nature that the patient reeled in walking and leaned forward when he wished to walk. The arms were somewhat weak and there was difficulty in speech. He was not able to make himself understood by a person at a little distance. Other sensations and intelligence were unaffected. The trunk muscles had the appearance of a paralytic. Saliva ran from the mouth during speech. There was no trembling of any part of the body, no colic, constipation nor derangement of digestion. He was given mercurials, vesication of the head and dorsal spine and strychnine, but all without effect."

Following these two cases three others developed, but when these men were promptly removed from their work, the early symptoms which they displayed disappeared.

Many years then elapsed before manganese poisoning was again described. On October 7, 1901, R. von Jaksch (2) described three cases which he considered atypical instances of multiple sclerosis of the brain and spinal cord. Von Jaksch described these cases very carefully and commented upon the fact that they were all employed as grinders of manganese dioxide in the same factory and that they all attributed the disease to their work. He was evidently unwilling, having failed to note Couper's (1) publication, to fasten such an extraordinary disease picture upon manganese and finally made the diagnosis of multiple sclerosis and believed the inordinate changes in temperature to which these men were subjected to have been the direct cause of their disease.

A summary of the history and physical examination of one of von Jaksch's patients will be of interest and should be compared with the history and physical examination of the typical American cases.

Von Jaksch's Case

History.—M. J., a workman aged 19 years, with an unimportant family and previous medical history, was first seen on Jan. 31, 1909. This patient had been employed from March, 1900, until Dec. 18, 1900, in the drying of manganese dioxide slime, the process of which was as follows: The slime was pressed, washed with water and in the form of cakes consisting of 60 per cent. water, 2 per cent. calcium salts, and the remainder rectified manganese dioxide, was spread out on large plates and heated to 100° C. M. J. together with the other two patients of von Jaksch had to break up lumps of this material and stood on the plates in wooden shoes to do it. A great deal of dust accompanies this operation (3). On Dec. 4, 1900, the patient noted a certain weakness of the legs which made walking difficult. Two weeks later he experienced a sudden trembling and shaking of the arms and legs and about the middle of January his gait became as it was at the time of examination. He felt stiffness in the knees which made pronounced bending of the legs impossible. At the same time he found he could not walk backward without falling and speech became noticeably slow.

Physical Examination.—On Feb. 3, 1901, a general physical examination proved quite negative, heart, vessels, lungs, abdomen, development, color of skin, etc., being normal.

Course of the Disease.—On Feb. 5, 1901, the patient exhibited very marked uncontrollable laughter occurring without any cause; long words were spoken with difficulty; he was able to count from one to ten and back monotonously but accurately, and seemed quite sound mentally. His pupils were equal and reacted normally and no nystagmus was recorded. The outstretched tongue moved slightly to the right; movements of the arms were somewhat uncertain but fine movements of the fingers were well made; there was a marked tremor of the right hand when the arm was outstretched, and the grip was strong. There was no ataxia of the legs; the patellar reflexes were increased; moderate ankle clonus and Romberg's sign were present; and the patient could not stand on the right or left foot alone. There were no sensory disturbances of any kind.

The patient left the clinic on Feb. 12, 1901, but his condition, especially his speech and gait, became worse and he came back to the hospital on April 20, 1901; his gait was spastic and he indulged in constant motiveless laughter. On April 22, 1901, he still showed uncontrollable laughing and crying and fatigued greatly in walking. Bilateral ankle clonus was present and the knee jerks were much increased. On May 3, 1901, he was discharged with no mention of improvement.

The other two patients described by von Jaksch worked with manganese in the first instance six months, and in the second eighteen months before showing symptoms which are quite similar to those we have quoted.

H. Embden (4) on Oct. 15, 1901, described two patients in an address to the Medical Society of Hamburg and later in the same year reported these cases with two others in the communication to which reference is given. These cases he diagnosed correctly as chronic manganese poisoning. All occurred in men engaged in grinding manganese dioxide, after sev-

eral months' exposure to air filled with very fine dust. To the symptoms already enumerated Embden's account adds:

"Considerable tension in repeated active and passive motions. Increased tonus of facial muscles, mask-like appearance. . . . On stepping downstairs, the patient is compelled, after losing control of several steps, to take two or three plunging steps forward . . . . In writing, marked disturbance occurs in some cases, tremor in any case, caused by the increased tension of the muscles concerned in the course of action. There is a continual diminution of the letters until after a few words or lines the writing becomes illegible . . . . Edema of the lower extremities was observed. . . . One patient, who earlier had normal speech, developed later with the other symptoms, marked stuttering."

In 1903 Friedel (5) and Seiffer (6) reported the most characteristic of the foreign cases, and Seelert (7), in 1913, gave a very complete review, not only of Friedel's original findings in 1903, but of the condition of the patient in 1913. His article is illustrated and gives an excellent idea of the entire condition. Seelert's work, together with two other papers by von Jaksch (8), (9) sum up the fifteen cases of manganese poisoning described in Europe.

Seelert's patient presented in summary the following findings:

Seelert's Case

History.—The patient, R. B., was a married man aged 44 years, and the father of six healthy children, three of whom were born after the beginning of his illness. His previous medical history was negative. From the autumn of 1898 to the end of 1902, R. B. had worked as a grinder in a manganese dioxide mill. After one year's employment "a faintness and fatigue came upon him, which gradually increased to heavy lethargy so that the patient fell asleep as soon as he lay down, and at every available time, even in the one-hour noon recess." A little later involuntary rhythmic nodding of the head began, attacks of this nodding appearing without warning and lasting uninterruptedly for a few minutes. Bodily movements became slow and awkward though muscular strength remained good. In March, 1901, he noticed that his voice was low and toneless. Uncontrollable laughter and weeping appeared in the early part of his illness. He continued to work until the end of 1902, when he gave up his job.

Friedel (5) described the condition of this patient in 1903 as follows:

"February 17. Out of the open mouth clear saliva flows constantly in great quantity. The facial expression is that of a rigid, constant smile. The speech is low, monotonous, disjointed, and almost unintelligible. The gait is heavy and awkward with a slight forward propulsion, the upper part of the body swaying unsteadily. The general appearance is that of old age. Patellar reflexes are unchanged, the light reflex preserved. During the examination, the lips and cheeks began to show fibrillary tremors and at the same time there was a clonic spasm of the neck muscles which moved the head in slow rhythmic shaking movements about a vertical axis.

"February 25. Urine free from albumin and sugar. Sputum examination negative.

"April 24. Urine examined for manganese with negative result, a finding not surprising since the patient had not worked in the dust for four months.

"On repeated examination during 1903, there has been no evidence of any sensory disturbance, no disorders of the bladder nor rectum, and no loss in power nor electrical irritability of the general musculature. Also the Romberg and Babinski phenomena have been constantly lacking together with every trace of ataxia and every sign of psychic derangement, apart from the uncontrollable laughter and crying. Pupillary reactions, fundi, visual fields, and eye movements have been normal throughout. Only after persistent looking to one side does the slightest nystagmus occur."

Physical Examination.—Examination in 1905 and 1906 showed no change in the condition of the patient. Seelert (7) in 1913 found a striking rigidity of the muscles throughout the entire body. The following description contains the important points in Seelert's own account of the case:

"The patient's features with the wrinkled skin about the eyes and the wide open mouth have continued in a fixed smile, which goes over into uncontrollable laughter from trifling emotional cause. In the same way low weeping frequently occurs. These emotional explosions are distressing to look upon and the patient is incapable of interrupting them. Their intensity stands in no proportion to the accompanying emotion.

"The ability to use opposing groups of muscles quickly and alternately is disturbed. In walking the legs are rotated inwards. The feet touch the floor only with the region of the metatarso-phalangeal joint. The patient is able to walk flat-footed, but after a few steps the tendency to abnormal placement of the foot appears. During walking he is incapable of stopping immediately at a command, but retropulsion is much stronger than propulsion. There is awkwardness in finger and arm movements but no loss of strength, and no alteration in electrical nor mechanical irritability of the muscles. There is no ataxia and no intention tremor, though a quick tremor of the hands is present.

"Periosteal and tendon reflexes in the arms are vigorous, patellar and Achilles tendon reflexes equally so. There is a suggestion of ankle clonus. Sensation is altogether normal. No eye-ground changes nor alterations in color or form fields. Pupillary reflexes and ocular movements normal.

Sensations of hearing, smell and taste normal. "Speech is indistinct, monotonous, low and has little timbre. There is no scanning nor hesitation. The vocal cords are normal. No psychic disturbances at the present time." (Uncontrollable laughter and crying were recorded in 1903 but were apparently non-existent ten years later.)

Laboratory Findings.—The urine was free from albumin and sugar and there was no alimentary glycosuria nor levulosuria. The Wassermann reaction was negative. Blood pressure was normal.

Seelert (7) sums up his experiences and those of other foreign workers as follows: "The symptoms which the patient presents remind one very much of severe cases of multiple sclerosis, but the diagnosis of manganese poisoning may be maintained because of the complete identity the disease has with all original cases. In every instance it has occurred in men who were employed in the manganese dioxide industry. In all, the symptom of stiffness of the musculature is prominent with the same secondary appearances, aggravation of active and passive flexibility, retropulsion and defect of speech. Von Jaksch described the peculiarity of gait our patient presents so markedly. There have never been any sensory disturbances, nor any involvement of bladder and rectum."

Casamajor (10), in 1913, described nine cases occurring in workers in an American mill and it is from this same mill, driven to extreme intensity of production as a result of the war, that our cases, with one exception, have come. Casamajor's experience, as in the case of the foreign authors, was altogether with advanced stages of the disease. His description of symptoms is very complete and includes reference to entirely negative findings in the blood and urine, as well as in the spinal fluid.

CAUSATION

The fifteen foreign cases have invariably occurred in men exposed to manganese dioxide. One American patient developed the disease as a result of eight months spent in shovelling Japanese manganese ore into a hopper, an extremely dusty task. This ore contained manganese as manganese dioxide. The remaining thirty-eight cases, comprising all men presenting suspicious or definite symptoms with whom we have had contact, have occurred as a result of work in dusty parts of a mill engaged in separating manganese from other ore. The crude ore from this mill contains 9 per cent. manganese, combined as oxides and silicates. It is significant that lead never appears in the crude ore except in the most minute traces and arsenic is entirely absent.

The process of separating the manganese is a dry one, the manganese and iron fractions being removed early in the operation by the use of very large magnetic separators. The mineral dust is carried on wide conveying belts between the poles of extremely powerful magnets. The iron- and manganese-containing particles at once move toward the nearby magnetic pole, which they are prevented from reaching by a second conveying belt, passing between them and the pole in question. They cling to the under side of this conveying belt until carried outside the main strength of the magnetic field, where they fall into a hopper. The ore dust must be extremely fine and dry to lend itself successfully to such an operation and in the drying, conveying, and separating there are large opportunities for impregnation of the atmosphere with dust. The amount of dust in the air has been greatly reduced by the introduction of an elaborate suction and bag filter system.

Casamajor (10) has called attention to an article by Schlockow (11) describing a peculiar and very slowly developing condition of poisoning in Silesian miners working with ore containing zinc and manganese, but with lead and arsenic also present. This description does not resemble manganese poisoning, nor has zinc in any form ever caused nervous symptoms of even remotely similar character. One has great difficulty in visualizing the disease picture presented by Schlockow but a combination of the known effects of lead and arsenic might possibly cause the syndrome which he described.

Portal of Entry.—Workers in a dusty atmosphere both inhale and swallow dust particles. In the case of lead it is apparently possible to develop poisoning through lung absorption alone or practically alone. Chronic poisoning with manganese, however, has never occurred so rapidly as with lead. In one instance we have knowledge of definite symptoms after one and one-half months' work. The most rapid development of permanent crippling either in this country or abroad

has required four months and five days' exposure to a dusty atmosphere. With such a rate of poisoning it is probable that absorption of manganese occurs both from the lungs and from the gastro-intestinal tract. The ore in question is readily soluble in the hydrochloric acid of the gastric juice (12). Particles reaching the lungs are undoubtedly coughed up and swallowed, together with an infinity of other particles which are swallowed directly. Reaching the stomach, the manganese is converted into manganese chloride and absorbed. Wichert (13) showed that soluble manganese salts are excreted in the bile. Kobert (14) and Cahn (15) found manganese in the stomach and intestinal contents after subcutaneous injection of soluble salts in rabbits. Harnack (16) found excretion of manganese into the intestine, manganese in the bile and a small amount in the urine—the latter fact having also been noted by other observers. Harnack confirmed the excretion of the metal into the bile by feeding a peptonate of manganese to an individual with an operative biliary fistula and obtaining manganese in the bile collected. Von Jaksch (8) believed the foreign cases to have been due to lung absorption, the manganese being combined eventually as an albuminate and carried to the nervous system in this form.

Unfortunately, no autopsy records nor animal work have as yet given us any idea of the distribution of manganese in the body after steady ingestion of a salt over a long period of time. In such an industrial operation as the one we have described, great importance in regard to prevention is generally laid on eating in dust-free environment. Hamilton (17) has recently re-emphasized the absurdity of very much emphasis on this contention in regard to lead. The poison is swallowed chiefly during the many hours the men work in the dust and is perhaps coughed up and swallowed after leaving the mill. An insignificant minimum is taken in with the noonday lunch, and elaborate lunch rooms, etc., though desirable features of a dusty mill, nevertheless will not greatly affect the incidence of poisoning as long as work in a dusty atmosphere is required.

Casamajor (10) comments on the possibility of a toxic effect from the extremely strong magnetic fields in which many of his patients worked. The facts that three pronounced cases in this plant have occurred in men who have never worked in the neighborhood of the magnetic separators; that the French and German cases are identical in character and have developed under the influence of manganese alone, and, finally, that careful animal experimentation, carried out by one of us, in so far as it has gone, fails to show the least effect from extremely powerful magnetic fields (at least four times more powerful than have been heretofore utilized in experimental work,—all these considerations combine to remove the magnets as final causes of the disease. Whether they may be a contributing cause is another matter. It has been suggested to us that the lungs of the worker in manganese dust when moved into a strong magnetic field may experience actual penetration of manganese-bearing particles, and that such particles, being embedded in lung tissue, will be more readily transferred to the circulation. This seems, perhaps, an improbable assumption, but it is fortunately susceptible of experimental attack and can thus be cleared up in the near future.

PATHOLOGY

The symptoms of chronic manganese poisoning are strikingly definite. Once seen, the condition will not be confused with any other clinical entity. The implication of a clear-cut attack upon some one portion of the neuromuscular apparatus is, of course, conveyed by a syndrome of such fixed type. There are no post-mortem data on any of the foreign cases: the disease itself has never been fatal either in Europe or in this country. Casamajor (18), however, has reported a single autopsy upon an advanced case of manganese poisoning, the patient dying of pneumonia. His description may be summarized as follows:

Gross observation showed no changes in the brain, kidneys, liver, nor spleen. Microscopical observation showed the following changes:

Kidneys.—A moderate chronic interstitial nephritis was present.

Liver.—There was considerable biliary cirrhosis and the liver cells contained much pigment, the majority of the granules being iron-containing.

Brain.—"There was some degeneration of more or less regular character in the longitudinal fibers in the pons which run

with those of the pyramidal tracts. While these degenerations are regular enough to be assembled into clearly defined tracts, nevertheless, it was not possible to determine exactly either the upper or lower level of the tracts in question. The degenerated portion does not appear to go above the upper level of the pons, nor does the lower portion extend to any appreciable extent into the medulla. . . . The pyramidal tract elements are clearly defined, and those of the fronto-pontine and temporo-pontine tracts are fairly so."

In our present state of knowledge these findings do not lead to any conclusions whatever. Stöcker (19), in describing a case of progressive lenticular degeneration, mentions the fact that one must always be certain, in making a diagnosis of this disease, that the patient has not worked in manganese, since the symptoms of chronic manganese poisoning and those of this rare nervous disease are strikingly similar. It is unfortunate that we have no record in Casamajor's (18) autopsy of a definite examination of the lenticular nucleus. While gross changes, such as were found in Wilson's (20) instances of lenticular degeneration, could not be expected except in the most extreme grades of manganese poisoning, grades never found clinically, it is possible that microscopical degenerations may have existed. The syndrome presented by Wilson under the title, "Progressive Lenticular Degeneration: A Familiar Nervous Disease Associated with Cirrhosis of the Liver," has marked similarity to paralysis agitans, and indeed such cases have been called juvenile paralysis agitans (19). Wilson, while not the first to describe the condition, has given the first thorough account of lenticular degeneration and his paper contains much material of interest in relation to manganese poisoning. In mentioning this similarity it should be noted that Wilson's very careful microscopical examinations contain no mention of the lesions in the pons described by Casamajor (18) (cf. p. 187). If these lesions represent the pathology of manganese poisoning, which Casamajor does not claim, there is no known pathological similarity to lenticular degeneration. Future observation may clarify the whole question.* Animal experimentation in the hands of both von Jaksch (8) and Casamajor has proved entirely ineffectual in reaching the true pathology. Possibly more intensive experiments may bring success.

COURSE OF THE DISEASE

This is best given through the media of clinical histories of several of our own cases.

Report of Cases

Case 1. *History.*—An American mill hand, single, aged 30, with negative family history and previous personal history, was first seen on June 19, 1918. He complained at this time of finding it "hard to walk." The patient first became a mill hand in 1904, and was employed in dusty work as a brusher on the screens. He had no cough while so employed and noticed no symptoms until a year and a half later. During this period he was shifted about upon various jobs in the mill. His first symptoms consisted in a "twitching" of the fingers and legs. If he stood all day he had a bad night on account of hard cramps in the legs; otherwise he had a pronounced tendency to sleep. It is still true that fatigue produces twitching and cramps so that the patient never walks far. After the onset of symptoms, the patient stopped work for a year and then came back in a dust-free job. In 1908, being apparently in good condition, he again worked as a screen man for seven months, when poisoning again became noticeable, and he was given light work. On Nov. 29, 1913, he was pensioned.

There is a vague history of constipation and indigestion while at work in the dust but no record of cough. He remembers clearly that nocturia once or twice was the rule while working but this has now stopped. Periods of uncontrollable laughing and crying have been present since early in his history. He cannot give the date of onset of these symptoms. Cramps in the legs were marked and rather incessant in 1913, but have improved so that they do not occur now unless he has had a very active day. The patient's hands no longer twitch unless he is very tired, and his legs are subject to the same rule but are less easily controlled than his hands.

Physical Examination.—The patient, a slender man, stands with his feet slightly apart and in this position does not sway. His memory is good and he gives an account of his positions and work since 1904 which checks perfectly with the mill report. His replies are somewhat hesitant but he is positive about assertions once made. His reputation is that of being mentally subnormal, possibly because of his slowness of speech and his constant foolish smile. This foolish smile is present most of the time, but the patient has no difficulty in controlling it when questioned and required to answer. His face is without wrinkles and displays the smooth fixation so characteristic of the disease. The pupils are equal and regular and react quickly to light and accommo-

*Readers interested in the clinical similarity between chronic manganese poisoning and progressive lenticular degeneration are referred to an article on "The Clinical Aspects of Chronic Manganese Poisoning," D. L. Edsall and C. K. Drinker, Osler Anniversary Volume, 1919.

dation: the sclerae are clear: there is no lacrimation, no lid-lag, no exophthalmos nor muscular palsies; the form fields are not restricted; slight, but easily elicited, nystagmus* is present. The fundi have not been examined.

The patient's voice is clear but his speech is slow, though there is no slurring nor difficulty in forming words. He makes rather frequent large swallowing movements of which he is apparently unconscious.

Examination of the lungs, heart and vessels shows nothing abnormal. The heart rate is 76 and the blood pressure normal. Abdominal examination shows nothing unusual with the exception of hyperactive reflexes.

Examination of the extremities shows a fine tremor of the outstretched hands and, in addition, frequent periods of tremulous movements more like the pill-rolling tremor of paralysis agitans than anything else. Biceps, triceps, and radial periosteal reflexes are equal on the two sides and slightly exaggerated. Examination of the legs shows no muscular wasting, paralysis, tenderness, nor edema, and no fine tremors. There are rather infrequent periods of rapid movements of the heels by the calf muscles. These spells of "teetering" are not accompanied by pain or cramp. Patellar and Achilles tendon reflexes are exaggerated and equal on the two sides. There is slight ankle clonus, no patellar clonus. The Babinski reaction is absent. The patient cannot stand with feet close together but falls in any direction when so placed. He presents the characteristic slapping gait of the disease and walks successfully with his eyes closed. Retropulsion is marked and propulsion is easily brought out when the patient stands on his toes. There is no intention tremor and no incoordination in finger to finger and finger to nose tests. There is slight resistance to passive movements. There are no disturbances of sensation of any sort.

Laboratory Findings.—Routine blood and urinary examinations gave entirely normal results.

Summary.—A boy was employed in dusty work for one and one-half years and was then compelled to cease work on account of twitching of the fingers and legs and on account of cramps in the calves. About three years later, being apparently well, he again worked in heavy dust, and after seven months noticed a tendency to fall and felt weak and tired. Being removed to dust-free surroundings, he did not recover but showed uncontrollable laughter and crying, cramps in the legs, and a certain amount of muscular twitching. On physical examination he displays no prominent mental deficiency. His face is smooth and constantly smiling. Speech is very slow. There is a fine tremor with periods of "pill-rolling" in the hands. The legs display tremor and twitching. All tendon reflexes are somewhat increased. Ankle clonus is present, likewise retropulsion and propulsion. There is no evidence of any sensory disturbance.

CASE 2. *History.*—An American mill hand, aged 47 years, with negative family history and previous personal history, was first seen on June 22, 1918. His complaint was that he "walks bad." The patient came to work as a mill hand in October, 1909. He was first employed as a cleaner. After three months as a cleaner, he became a machine tender, and continued in this employment for about ten months. One month after being employed, he noticed persistent cough, and two months later that his legs "seemed to be stiff." After three or four months both arms and legs began to twitch. He has never had cramps in the calves nor in any muscles. He falls frequently both backward and forward, and it was on account of falling that he finally gave up work in 1910.

The most conspicuous feature of the disease in this patient has been the extensive muscular twitching. His left leg is in a constant "teetering" motion during the taking of the history, and his right leg falls into the same condition occasionally. There is a gross twitching of the hands, sometimes of the fingers and sometimes of the hands upon the wrists, which is absolutely continuous and which has not changed in any degree since 1910. The patient has never noticed any intensification of his twitching from fatigue. The patient's memory is unimpaired, and his general mental reactions accurate but very slow. Cough has disappeared since leaving dusty work, as has also a slight tendency to frequency in urination evidenced by nocturia twice nightly while in dusty work.

Physical Examination.—The patient is a large, well-built man with a stolid, ironed-out face and stands with feet wide apart and without swaying. This patient has never had any emotional lability during his entire experience with the disease.

Examination of the eyes shows a large corneal scar in the right eye. The left pupil is regular and reacts normally to light and accommodation. There is no nystagmus nor contraction of form fields. His teeth consist of old snags only and there is very bad pyorrhea but no pigmentation. The voice is low and there is no slurring nor stuttering in speech. The tongue, tonsils and pharynx are normal. Words come very slowly and are used with a curious economy.

Examination of the neck, thorax, lungs, heart, and vessels shows nothing abnormal. The blood pressure is normal. Examination of the abdomen shows no tenderness nor palpable masses. The abdominal reflexes are exaggerated.

Constant tremulous movements of all muscles of the arms are conspicuous. These never stop entirely but groups of fibers in different parts of the muscles fall in and out of activity. This is particularly noticeable in the pectorals, which, however, never contract vigorously enough to move the arms. The forearm muscles have enough coordinate activity to cause a constant coarse tremor of the outstretched fingers and frequent movements of the hands on the wrists. Biceps and triceps reflexes are present, equal on the two sides and somewhat exaggerated. Radial periosteal reflexes cannot be obtained. No muscular atrophy, tenderness, nor abnormal weakness.

*This is the single case in which we have seen nystagmus. It was so slight in this instance that we take it to have been accidental and of no importance.

There is constant twitching in all the muscles of the legs, particularly evident in the gastrocnemei and best seen in them when the patient stands supported on his toes. He is unable to stand with feet together unsupported, and falls backward at once. There is no increase in tendency to fall with the eyes shut. The gait is very characteristic and well carried out with eyes closed. Shoes are worn equally over the entire sole. This is characteristic of all these patients, and emphasizes the necessity of placing the whole foot on the ground at once, thus keeping as wide a base as possible. (The patients we have seen do not tend to walk upon the region of the metatarso-phalangeal joint as emphasized by von Jaksch.) Retropulsion and propulsion are marked. Achilles and patellar reflexes are present, equal, and much exaggerated. There is marked ankle and patellar clonus. Stretching of muscles in any part produces rhythmic muscular contractions. Thus, frequent tapping of the biceps muscle throws the muscle into clonus, which is maintained for some time. There is no incoordination in finger to finger and finger to nose tests, though the hands shake violently when brought together to the nose. Tremors are not increased by intention. There are no abnormalities of sensation of any sort.

Laboratory Findings.—Routine blood and urinary examinations gave entirely normal results.

Summary.—A man of forty-seven, after four months' employment in dusty surroundings, noticed stiffness of his legs, and three months later both arms and legs began to twitch. His total exposure to manganese dust was thirteen months. He exhibits, at the present time twitching, retropulsion and propulsion as his most conspicuous symptoms. On physical examination his face has characteristic smoothness. Increase in reflexes and clonus are very pronounced. He is altogether without sensory symptoms.

CASE 3. *History.*—An American workman, aged 38, with negative family and past medical history, was first seen June 22, 1918. His complaint was, "My legs—I can't feel good." This patient was married in 1906, and at the time of examination had one healthy child seven years old. The patient regards himself as normal sexually and his wife is quite well. (There has been no evidence of any sort of sexual abnormality in connection with manganese poisoning. Several patients have had children born since they were placed upon the pension roll of the company.) This patient has been known as a case of manganese poisoning since August, 1916.

He first went to work in the mill November, 1915, as a cleaner. This was a very dusty occupation and he continued in it until June, 1916, when he became an oiler on the motors, and in this capacity worked all over the plant, and was consequently in dust of varying concentrations. Shortly after taking this new work, he thought he had malaria, as he felt sleepy and out-of-sorts all the time. He, himself, noticed nothing the matter with his legs until his friends told him he was not lifting his feet up when he walked. He did not know that he could not walk backward until examined by the company physician in August, 1916. There were no cramps and no muscular twitching at this time. On August 31, 1916, he was shifted to dust-free work, as it had become evident that he was a definite case of manganese poisoning. During the next two years his walking gradually grew worse, but he did not experience cramps in the legs until just before leaving work entirely in April, 1918.

At present, he can work in the garden for about half a day and then his legs get "achey and weak so that he has to quit." After as much work as this the muscles in his calves "knot up", and he has noticed that this tendency to cramp is always distinctly worse after fatigue. He has never had much twitching, but occasionally it is noticeable in his legs when sitting down, and these periods always come when he is fatigued. Reading tires him. Writing is difficult, apparently because he has a distaste for attempting any muscular movements. (A similar distaste has existed in other cases and seems related to the concentration which goes with every use of muscles. The muscles are forced to perform work, and this forcing results in no appreciable gain in smoothness of action.) The patient has never shown any tendency to laugh or cry. His wife, ever since 1916, has noticed a tendency to sleepiness and detachment.

He walks forward very successfully and does not notice propulsion unless going down hill. Any influence, such as walking down a steep incline, which interferes with the protection which his gait offers him against propulsion, brings propulsion out. Recently, for instance, he lifted a box and started to walk forward. This weight brought him up on his toes and he at once commenced to run and finally fell. The patient rides a bicycle, but must have help to get on, and always ends his ride by falling off.

Cough came on after working a short time in the dust, and this was accompanied by profuse dusty expectoration. He has no cough at present and has not noticed that cough is a general complaint of men so employed. During the entire history taking the patient exhibited no twitching whatsoever.

Physical Examination.—The patient stands normally and shows no loss of flesh. He is mentally alert and interested in the examination. His face is very smooth and expressionless, this feature of the disease being extremely marked. His pupils are equal and react normally to light and accommodation. There is no nystagmus nor paralysis of the external ocular muscles and the form fields are not restricted. The fundi were not examined.

The tongue is protruded in the middle line and shows a slight fine tremor. There is no abnormality of the voice or of enunciation.

Examination of the thorax and lungs shows nothing. The heart is not enlarged. Occasional extra systoles are heard which are apparently ventricular in type. There is no sclerosis of the vessels and the blood pressure is not elevated. The abdomen and genitalia are normal.

There is no wasting nor paralysis and no tremors of the extremities. Occasional coarse twitching of the arms and forearms occurs. Biceps, triceps, and radial periosteal reflexes are

present, equal, and exaggerated. Clonic movements of the muscles cannot be elicited. Finger to finger and finger to nose tests are well performed. There is no wasting, twitching, nor tremors of the legs. Patellar and Achilles reflexes are present, equal and exaggerated. No ankle nor patellar clonus can be brought out. The patient cannot stand with feet together in this position—he falls backward. This is no worse with eyes shut. The patient's gait is characteristic. The legs are kept rather far apart, the feet lifted very slowly and slapped rather evenly on the floor, the shoes being worn equally on all parts of the sole, as is characteristic of all patients who show the gait well. Propulsion and retropulsion are easily brought out. Sensation is normal.

Laboratory Findings.—Routine blood examination disclosed nothing abnormal. The urine was not examined.

Summary.—A man of thirty-eight, after seven months of dusty work noticed sleepiness and general malaise. After nearly a year's time retropulsion was discovered. His gait became gradually worse and eventually cramps in the legs became troublesome. At present he is easily fatigued and has a distaste for attempting finely coordinated movements. His face is very smooth. He presents tremors of the arm muscles and some increase in tendon reflexes both in arms and legs. He cannot stand with his feet together. Retropulsion and propulsion are marked and there is the characteristic protective, slapping gait.

As we have seen chronic manganese poisoning the following findings make the syndrome. We have numbered them in the most common order of appearance. It is difficult to emphasize in any written description the clearness with which the symptoms come out and the ease with which the diagnosis can be made.

1. A history of work in manganese dust for at least three months.
2. Langour and sleepiness.
3. Stolid, mask-like facies.
4. Low monotonous voice. Economical speech.
5. Muscular twitching, varying in degree from a fine tremor of the hands to gross rhythmical movements of the arms, legs, trunk and head.
6. Cramps in the calves and a complaint of stiffness in the muscles of the legs, the cramps usually coming on at night and being worse after a day of exertion.
7. Slight increase in tendon reflexes.
8. Ankle and patellar clonus. Frequently by stretching any of the muscles of the body it is possible to elicit rhythmical contractions. Romberg sign is inconstant: there is no incoordination.
9. Retropulsion and propulsion.
10. A peculiar slapping gait. The patient keeps as broad a base as possible, endeavoring involuntarily to avoid propulsion. The shoes are worn evenly and we have not been able to convince ourselves of the pronounced tendency to walk on the region of the metatarso-phalangeal joints, a feature strongly emphasized by von Jaksch (8).
11. Occasionally, uncontrollable laughter; less frequently crying.
12. Uniformly absent are any disturbances of deep or superficial sensation, eye changes, rectal, genito-urinary or gastro-intestinal disturbances, reactions of degeneration, blood, urine, and spinal fluid alterations. It is significant that, unlike lead, manganese produces no life-shortening degenerations. Seriously poisoned men are long-lived cripples. The metal apparently makes a very definite attack upon some non-vital portion of the neuromuscular system, destroys it thoroughly, if time for action is permitted, and leaves the victim quite well in every other respect.

We have never seen either the salivation or edema described in foreign cases.

TREATMENT

After the harm has been done there is no form of treatment which has any value. Early cases recover spontaneously, if placed in dust-free environment. The problem therefore becomes one of prevention alone.

PREVENTION

Wagener (3) and Friedel (5) have given summaries of this phase of the subject, but their directions are not based upon observations on enough cases to lay down thorough directions.

It is clear that dust removal will destroy the possibility of disease incidence. The extent to which this must be accomplished cannot be given exactly. Apparently some of the German cases working in a dust of practically pure manganese dioxide have been more severe than any, with one possible exception, seen in this country. If the metallic concentration in the dust breathed is high, removal must be proportionately more complete. In this regard it is interesting to note that we have never seen a case of manganese poisoning develop as a result of work in a very thick

dust averaging 5 to 6 per cent. of manganese, while in the same neighborhood the cases we have described have come from a mill, also thick in dust, with a manganese concentration of 9 to 12 per cent. This latter concentration seems to be just able to poison if present in air thoroughly laden with dust. Manganese is apparently only slightly toxic and susceptible individuals are few. As a consequence it is probable that poisoning can be controlled in processes where total dust elimination is difficult, if the elimination is at least partially successful. Where, however, any possibility of poisoning exists, special measures as to physical examination of employees should be taken. We have said that the shortest period of exposure resulting in permanent disability of which we have knowledge is four months and five days. We have seen the development of very clean-cut symptoms in one month and fifteen days. Couper (1) had recovery in three cases showing minor symptoms—the character of which he does not give—on removal from dusty work. Our experience corroborates this. The disease must advance to a considerable degree to be dangerous, but in this regard caution is necessary since each man after several months' dusty work possesses a reservoir of dust in his lungs which is absorbed directly and also coughed up and swallowed. Consequently, on appearance of symptoms, it is essential that removal from dusty surroundings be accomplished at once, leaving the patient nothing to contend with save the dust already swallowed. Our examination of the problem has caused us to institute quarterly physical examinations for men working in dusty parts of the mill which has produced our cases. These are recorded upon cards of the following type:

EXAMINATION CARD

Name .... Nationality ....

Date and Age First Employment .... Pay Roll No.

DATE AGE

KIND OF WORK		Weight	History of Sleepiness, Weakness or Cramp	REFLEXES		CLONUS		Tremor or Twitching	Propulsion, Retropulsion and Gait	General Remarks Speech Cough Facies Salivation	Employment Record
Date	Work			Biceps	Knee Jerk	Ankle	Patellar				

Such examinations can be made extremely rapidly and have worked well. Early cases are detected readily, and changed to dust-free jobs before harm is done.

As in the case of lead poisoning, ma-

lingering and even a definite manganophobia occur. Unlike lead, manganese is clean-cut in its attack and while such instances must make occasional trouble they can never escape eventual detection.

In conclusion, it is the urgent hope of the authors that industrial physicians having opportunities to observe men handling manganese compounds will be on the alert for poisoning and will see that their observations reach the literature upon the subject.

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PUBLIC HEALTH NURSING AND INDUSTRIAL HYGIENE*

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IT has been said repeatedly that nursing is the right arm of the medical profession. Certainly it is true that public health nursing is the right arm of preventive medicine, for upon the successful administration of public health nursing the actual accomplishment of many of the plans conceived by the public health officer or the industrial practitioner must depend. This is because we must look to the enlightenment and persuasion of the public and not to the aribitrary enforcement of a law for any permanent improvement in public health.

For the last thirty years and more there has been in this country a body of community health visitors known as district nurses or as visiting nurses. In most of our large cities there is an unofficial health association, known as the "Visiting Nurse Association" or the "District Nursing Association,"the purpose of which is to shape the policies governing this form of health work and to raise the budget necessary to maintain it. In 1918, the Chicago Visiting Nurse Association spent $165,461.25; the Boston Instructive District Nursing Association, $129,114.93; and the Philadelphia Visiting Nurse Society, $78,317.64. The health work undertaken by these various associations differs more or less with the differing opinions of the board of directors in one or another city. In many small towns and in many country places the people have come to believe that a visiting nurse is a necessity to the community. One of the oldest of these associations is the Instructive District Nursing Association of Boston. Its act of incorporation plainly states its purpose "to give nursing care to the sick poor" of Boston. Such expressions as this are to be found in the early reports of most of the large visiting nurse associations. They show, first, that the origin of such work was frankly a "charity"; and, second, that the preventive work, which was done by the nurses in the early days of visiting nurse associations, was only such as came incidentally to the bedside nurse, who "instructed in the laws of wholesome living" while she made a bed, gave a bath, and carried out a doctor's orders. This early phase of public health nursing laid a valuable foundation for the work of to-day, in creating a welcome and an understanding in the neighborhoods where the nurses worked. This friendly feeling toward the nurse was a valuable asset to the modern movement, but it has taken some time and will take longer still to efface the impression created in the community, that all visiting nurses are charity workers, and, as such, not acceptable to an independent public, even though they are desirable for those neighbors (constituting 50 per cent of a city community), who are unable to pay for medical care, preventive or otherwise.

When, in the year 1893, the Henry Street nurses began their work in New York City, an important step in the progress of public health nursing was taken by encouraging the payment of a small fee for each visit, and so emphasizing the public service rather than the charity aspect of visiting nursing.

A community service for which anyone may pay becomes very popular when it is a service which may be needed at any time by any family in the neighborhood. There have been remarkable results due to the home nursing performed in this way under the direction of visiting nurses. The technical nursing, performed by the nurse herself, during her short stay in the home, is of comparatively little value because after her visit nursing care may be entirely suspended until she comes again. Of much more consequence to the family is the ability of the visiting nurse to teach the elements of home nursing to some member of it. This teaching is capable of producing good results in recoveries from illness and in prevention of the spread of disease. It has been a matter for later experience to see the infinitely greater value of so educating visiting nurses and organizing their work that they will undertake the systematic health teaching

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which means prevention of the occurrence of disease, the correction of remediable defects, and the avoidance of that underweight and undernourished condition so often observable in family visiting. In a more or less desultory manner, health teaching or preventive nursing accompanied the demonstrations by means of which home nursing was taught. Many visiting nurses, in the early days, taught prenatal care and undoubtedly did much valuable preventive work, but until about 1900 there was no organized attempt to bring the laws of preventive medicine directly into homes and schools and industrial plants through the agency of the visiting nurse. Dr. Mock, in his interesting article in the May issue of THE JOURNAL OF INDUSTRIAL HYGIENE, in which he traces the development of industrial medicine and surgery, makes no mention of the industrial nurse and yet in all these important ten years during which industrial medicine and surgery have been so rapidly developing, the industrial nurse has been present in many plants and has been an active influence in fostering within the walls of the factory, that interest in public health without which there can be no permanent improvement in health conditions. If public health nurses are indeed the "right arm" of preventive medicine should they not be given due recognition?

Four years ago, nearly half the ten years during which we have seen the rise of industrial medicine, the Boston Association for the Relief and Control of Tuberculosis created a small sub-committee on health in industry. An executive secretary was engaged, whose chief function it was to persuade various employers of labor of the value of industrial nurses. The secretary, Mrs. Anna M. Staebler, is still occupying this position. She herself is a graduate nurse who has had special preparation for public health nursing. The efforts of this committee have been successful in establishing many industrial nurses in plants where, up to the time of their employment, no health work had been attempted. Of course there is the danger, when a factory begins health work with a public health nurse, that the management will believe it has done all that can reasonably be expected to guard the health of its people. The greatest safeguard against this danger will lie in the nurse herself whose knowledge of current developments in industrial medicine and whose enthusiasm for better health facilities for her people should enable her to help greatly to secure them.

About the year 1905, the leaders of the anti-tuberculosis movement began consciously to realize the need for homely visits made systematically for the purpose of teaching, by means of demonstrations, the way to prevent the spread of tuberculosis; to hunt up exposed persons (not always an easy task) and to persuade them to have a physical examination; and at the same time to induce those patients remaining at home to follow the directions given them by the doctor.

In 1909, the first meeting of the American Association for the Study and Prevention of Infant Mortality was held. The formation of this association, with the spread of educational propaganda resulting from it, greatly increased the demand for visiting nurses to go into homes for the purpose of teaching, by practical demonstration, those simple facts about the care of babies so essential to their health.

In 1902, school nursing was established first in New York City, and soon afterward very generally throughout the country. In this branch of visiting nursing also, the nurses' most important function is to teach through demonstration, in order that those defects discovered in the schools, through inspection, may be remedied. All these newly organized teaching bodies found their practice ground in the home. Graduates of schools of nursing were selected to do this work because there is in the hospital course a certain background of training valuable for a public health nurse to possess. Neither in 1900 nor in 1919, however, has the education of a nurse been of a kind to fit her to become a successful public health teacher and visitor. Many public health nurses, like the writer of this article, can testify to this out of their own experience of having struggled into this new profession of public health nursing with no preparation other than that afforded by a hospital training school.

The subject of proper preparation for public health nursing is too large for this paper. It is, however, of vital interest

and importance to all who are engaged in public health administration.

The consequence of rapidly filling the demand for school nurses, tuberculosis nurses, and well-baby nurses from among the ranks of graduate nurses, with no experience or special training, was just what might be expected. The newly recruited workers were severely and sometimes justly criticized because they had such an inadequate knowledge of social conditions, of the principles governing social work or the agencies established to carry it on, because they were ignorant of what constitutes a properly balanced diet and of how to adapt it to age-old customs brought here from other countries; because they knew nothing of applied bacteriology, or of social legislation; and, more than everything else, because they had had no practical experience in visiting in homes and so learning how public health teaching may be done. Public health nursing has, through a great many difficulties and a great deal of criticism, come to a place of some importance in community health work. Upon the number of public health nurses in a community and more particularly upon the quality of work which they do, must depend chiefly the lowering of the mortality rate of that place and the reduction of its morbidity.

Community Nursing

The public health or community nurse of to-day is concerned chiefly with the family and not chiefly with the individual. She is much more interested in preventive teaching than in any other function which she may perform in the homes to which she goes. She is engaged in what Florence Nightingale described as "well-nursing" in contrast to sick-nursing, although she must, if she is to be an effective teacher of home nursing, frequently demonstrate the technique of bedside nursing. She may belong to any one of the following groups of nurses:

1. Anti-Tuberculosis — Administered by Board of Health or Private Society.
2. Child Welfare — Administered by Board of Health or Private Society.
3. School—Board of Education.
4. District or Visiting—Private Society.
5. Industrial.
6. Board of Health.

Varied as are these administrators of public health nursing and wasteful as is the present un-relation of one to another, there is a certain natural division of their work. Four of the six spend the greater part of their time in homes and the other two spend the greater part of theirs in the working environment from which adults and children will return to these homes; that is, in the schools and in the industries. A nurse from one group plays into the hand of a nurse from another.

The Present Moment in Public Health Nursing

We have passed out of the period of experiment and have come to some conclusions which leave no room for doubt. Many studies and surveys have been made in the last five years and the deductions drawn from them show that public health nurses can and do reduce mortality definitely and immediately when certain definite functions are performed by them. Fifty per cent. of infant lives are saved by prenatal nursing; maternal mortality is tremendously reduced when nurses are available for postpartum care also. In the schools the improvement in the percentage of regular attendance since school nursing was introduced shows how successful this work has been.

Many industrial managers who have health nurses as a part of their establishment will testify that it pays. Public health nursing administrators are now looking toward a step which will bring these improved health conditions into every family, every neighborhood, every school and every industry. The time has come when we can no longer content ourselves with the casual, haphazard methods of the past. The scattered trades such as the work of longshoremen, tailors, painters, carpenters are not as yet affected in any very intimate way by organized health work. There is a plan of neighborhood organization, described later under Community Health Center, that will make these health facilities, health clinics and health nurses, readily available to everyone.

We have been considering the subject of public health from the standpoint of some one of the specialties, or of an experiment. We are now on the eve of making our point of departure the unit

of population. The public is ready for this health unit idea as it never has been before. The revelations made by the physical examinations for the draft have brought home to many people the value of positive good health—health that means sound teeth, unbroken arches, unimpaired vision. Young men who have been in the service are coming back to their homes all over the country, having had the satisfaction of experiencing such a state of health for the first time in their lives. They value it and will want it for their children.

Another influence that has been at work to produce this moment of opportunity in public health nursing is the educational campaign which has been the result of "Children's Year," the work of the Children's Bureau and the Women's Council of Defence. To anyone who has not been closely connected with this work it is astonishing to follow the results of the past year and a half. Women of all degrees of education are for the first time fully aware of the loss of life among the babies in their particular town, of the reasons for this loss, and of the means necessary to prevent it. In this connection it is worth while to review the work of one state during the past two years. The Massachusetts State Department of Health formed a committee on child conservation in the very early days of our participation in the war. The committee was an advisory committee having power to act. The Massachusetts Women's Council of Defence with its sub-committee on child welfare became an integral part of the state committee. This was accomplished by including both chairman and vice-chairman of the Women's Committee in the Advisory Committee of the state Department of Health. The American Red Cross provided money for the immediate needs of the committee over and above what the state Department of Health could appropriate. This expense consisted of salaries and traveling expenses for the eight specially trained and experienced public health nurses who were immediately engaged to act as child welfare supervisors for the state. More than $70,000 was appropriated or given in various localities throughout the state for the work of child conservation, through the combined interests represented in this movement. Better than anything else has been the permanent and genuine interest in health aroused in towns and cities and rural communities, where before this time there had been very little.

The public health campaign of the Red Cross is a great force for the education of the people and has already greatly increased the overwhelming demand for specially trained public health nurses.

Nurses in Industry

The work of nurses in industry is almost entirely unstandardized. Some individual nurses have been able to develop excellent systems of public health nursing work in the industries to which they have been attached. Where industrial medicine and surgery have already been established in a plant, industrial nurses readily become a part of the general health plan. However, in many instances, during the past ten years, the industrial nurse has been the only health agent employed by the management. It is obvious enough that where minor accidents occur in an industry a graduate nurse is of value to give first-aid treatments. This, of course, is the smallest part of a nurse's work in a factory. Indeed, a good industrial nurse expects to see these minor accidents grow fewer as her influence in the factory grows. She does not encourage treatments, and deplores the necessity for them since it means that good preventive work has not been done. There is a type of visit to her office which the nurse encourages because it gives her an opportunity to advise while there is still time to prevent some impending ill. When a girl's confidence has been won it is easy to persuade her to have dentistry done, eyes examined, or even to change her manner of dress or her choice of food. It is the result of these friendly interviews that seems of most value to the management.

One successful industrial nurse described an important part of her work as "factory housekeeping", and certainly such housekeeping is much better done in plants where there is a good industrial nurse. Her presence alone suggests to forewomen and foremen that the sanitation of that part of the plant under their control is a matter of importance to the manage-

ment. Home visits are often made by industrial nurses. The visits are made for the purpose of looking up absentees, to see that there is proper medical care, and sometimes to help unravel a delicate social problem. The greater part of an industrial nurse's time is needed in the plant, and the better she is able to co-ordinate her work with that of the other public health nurses in the town, if there are any, the freer she will be for that purpose. Industrial nurses seem almost always to be welcome to the employees, perhaps partly because they are women and themselves employees, friendly and frank both with the workers and with the management.

In one large factory a girl had acquired a habit of fainting. Each time it happened all her colleagues in the great room where she worked stopped work and crowded about her in pity and curiosity. A considerable sum of money was lost to the firm in this way because, not only was work delayed, but the warm chocolate with which the girls were making *bon bons* was spoiled by being left and became a source of loss. After observing this once or twice the nurse sent for the girl wh fainted. She told her what it meant to the company to have the work stopped in this way, and told her that she was quite sure the tendency to faint could be controlled; finally, she told her that she could not continue to work at that business unless she did control it. Some weeks later this girl came to the nurse to say that this way of thinking about her ill-health had surprised her so much that she had never since that day been in the least inclined to faint, "even at home."

In a few words, we may say of the industrial nurse that among other things she acts as housekeeper and sanitary inspector, that she stimulates an interest in health, and that, being always on the spot, she is always accessible, although she discourages dependence upon her technical skill as a nurse; that she is proud when she can reduce the number of absences from work on account of ill-health by means of her teaching. She is a good interpreter of workmen to the employer and of the employer to the workmen. She is in a position to encourage and foster *esprit du corps*.

Co-ordination of Public Health Nursing in a Health Center

Mr. Michael M. Davis and Dr. Andrew W. Warner in their book on *Dispensaries* (The Macmillan Company, 1918) have given an admirably clear picture of the Health Center as it has been developed in this country.

In this book we read that because progress in the various public health movements has been so rapid each one of these movements must now consider not only the "pleasure of growth," but the "problem of co-ordination."

Certainly it is true of public health nursing. Heretofore, community health workers have begun in a neighborhood because each worker has been particularly interested in some specialty; in a disease, in young children, in industrial plants, in the public schools or in an effort to relieve the suffering caused by illness. Public health nurses have flocked to meet the enthusiasm of these special interests which become so absorbing that, to an outside observer of the neighborhood, these interests come to seem like so many "fads."

The conscious attempt to co-ordinate public health nursing interests and activities leads first to a common building where all the office work of all the neighborhood nurses is done. Mr. Davis and Dr. Warner (pages 318 and 319) describe a Health Center in the following outline:

1. A population unit, i.e.:
   a. The area and population covered is defined.
   b. The aim is to reach all the population so far as the health services offered apply.
   c. The results are measured by the 100 per cent. test, that is, not the number of persons reached effectively, but the proportion of the population which is reached effectively.
2. The co-ordination of local effort, especially
   a. Of the medical and sanitary services within the district.
   b. Of the nursing services, involving correlation or combination of various nursing specialties.
   c. Of social services, involving correlation or combination of neighborhood forces, and of the social agencies at work in the neighborhood.
   d. The local headquarters and clinics of all forms of public health work for a district to be within a single building.
3. A local administrative unit, involving
   a. A local administrative head.

b. Supervision of all special services by specialists working administratively through the local head.

Public health nurses working from such a neighborhood center would approach the needs of the community from a different starting point from that of the special interest. To begin with, the number of people in the area must be known, then the number of families, then the industries, the prevalence of sickness, the death rate by age—groups, nationalities, and also by sex, and finally the number of families for which each public health nurse could assume responsibility. Teaching home nursing by means of demonstrations of bedside care is a very great asset as a means of entry into a family and, for that reason alone, must be cherished as a valuable function by the community nurse who wishes to reach all her families.

Only about 47 per cent. of families in a city neighborhood are unable to pay anything for medical care. Many of the remaining 53 per cent. can pay the full cost of a nursing visit. It is not easy to enter these homes for the purpose of health teaching unless the entrance can be made by offering a service which the people want, and a good nurse is always welcome in a sick-room. The organization of a health center from which public health nursing is to be administered requires three distinct types of workers:

1. Health authority, represented by federal, state, county, or city health officers.
2. An active and representative committee of men and women living in the neighborhood.
3. Professional workers; that is, local doctors, specialists, such as oculists, dentists, pediatricians, obstetricians, and public health nurses.

It is difficult to say which of these essential groups is most important. There could be no success without all three. Upon the neighborhood committee rests the responsibility of voting policies and finding the budget; of developing local publicity through newspapers, moving picture houses, health bulletins, posters, public lectures, and through the numerous other ways each neighborhood will discover. The power of a local health committee like this cannot be overestimated. The responsibility of spending our own and our neighbor's money in such a way as to produce better health in our own community, and at the same time, better results than are being produced at an adjoining health center, is a force for the education of the committee and through the committee of the entire neighborhood.

This education in matters of public health through the responsibility of administration was one of the interesting effects of the Health Insurance Act in England. Early in 1915, the writer was in a little village in Devonshire. On asking how we could learn about the public health nursing going on there, we were referred to the local chemist. He was serving on the committee which administered the maternity benefits and his store of accurate knowledge about the service was as remarkable as was his enthusiasm and understanding of its value to the community.

When all is said, we must come back to the starting point of the suitable education of a public health nurse. Everything depends upon her ability to see her work from a high enough vantage ground to enable her to continue in it without too great discouragement, and also to enable her to keep her own enthusiastic belief in it vividly before the minds of her committee.

Supervision of special forms of public health nursing work by specialists is very necessary for the success of this form of organization. It is only when home nurses are responsible for the health of as many families as each can thoroughly supervise, and for not one more than that number, that we shall be able to observe the effect of co-ordinated public health nursing work. It is evident that home nurses greatly need the intimate knowledge of factory and school which the industrial nurse and the school nurse possess and it is equally evident that the family would profit greatly by a more intimate relation between all community nurses and by a plan of administration that puts into the hands of home nurses the knowledge gained by industrial and school nurses and *vice versa*.

Under such a plan, much of the home visiting now done by industrial and school nurses would be delegated to the nurse already familiar with the home, record keeping would be greatly simplified, edu-

cational propaganda would take a broader and more effective aspect, emphasizing the public health of the community rather than differing phases of the subject.

The question of financing public health work in the United States will not long remain unanswered. When Americans do decide in what way this bill shall be paid, the Community Health Center, with its local administrative committee, its connection with established health authority, and its organized groups of doctors and of public health nurses will be in an ideal position to administer the funds.

INDUSTRIAL POISONING BY COMPOUNDS OF THE AROMATIC SERIES*

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BENZENE

In the making of coke and by-products, coal is roasted and the lighter vapors, benzene, toluene and xylene, are absorbed in high boiling oils and subjected to fractional distillation. The danger from contact with benzene begins in the distilling house, and though in the ordinary working of a plant, there is no danger of industrial poisoning, any accident which results in a spill or which necessitates repair work, is attended with a great deal of danger. For instance, not long ago, a man was drawing off the water from the bottom of the benzene settling tanks. To do this he had to stoop down under the tanks. He was supposed to shut the stopcock as soon as benzene began to flow, but apparently he was not prompt enough, the fumes of benzene began to escape, he grew dazed, started to leave the place without turning off the flow, but collapsed on the floor where he was found some time later. Two men went to his rescue but in carrying him upstairs, one was overcome by the fumes and fell backward, breaking his neck. The workman himself was revived.

The lightest distillates are benzene, toluene and xylene; next come crude carbolic acid and naphthalene; then anthracene; and the residue is coal-tar pitch. The use of these different distillates is increasing very rapidly. While in 1914 they were expensive, being almost wholly imported from Germany, they are now manufactured on a large scale in this country and are rapidly displacing the less powerful solvents of the petroleum series. Benzene is used as a solvent for rubber in rubber manufacture and in making rubber cement. It is used in paint and varnish removers. It is present, together with the heavier bodies, in the coal-tar paint which is applied to water bottoms of ships and is used in painting bridges. Benzene is also the starting point for the ordinary method of making phenol and as a starting point for many of the aniline dyes and coal-tar medicines.

In benzene intoxication the brain and spinal cord contain relatively more of the poison than any other structures, probably because of the great solubility of benzene in fats and fat-like bodies, such as the lipoids of the nervous system. The effect on the blood is marked and characteristic. There is an anemia of the aplastic type and a great diminution of the white corpuscles. Capillary hemorrhages under the skin and mucous membranes are so common that the Germans call this form of poisoning *Blutfleckenkrankheit*.

Selling (1) carried on experiments in benzene intoxication in rabbits and succeeded in reducing the leucocytes almost to the vanishing point, yet without killing the animals. The diminution of red cells was slighter and less constant, averaging only about 16 per cent. as compared with a loss of 92 per cent. of white cells. This leucopenia is chiefly polymorphonuclear. He also found a profound destruction of the hemopoietic structures, especially the

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marrow, which was followed by regeneration. Fatty changes sometimes developed in the liver and kidneys; hemorrhages occurred into the lungs, pleurae and stomach.

Hektoen (2), noting that these experiments of Selling's showed a selective action of benzene on the tissues and cells that are concerned in the production of antibodies and in defense against infection, took up the question as to the effect of benzene injections on antibody formation and on the course of infections. He found, in rabbits injected with benzene, a reduction of lysins and precipitins, together with grave lesions in the marrow, leucopenia, and a reduction in the phagocytic power of the blood. He concluded that benzene may lower resistance to infection by reduction (a) of antibody production, (b) of the number of leucocytes, (c) of leucocytic activity.

Further experiments with benzene have been carried out by Rusk (3) of the University of California, who also found diminution of hemolysins and precipitins in rabbits injected with benzene and concluded that since in these rabbits the marrow and lymphatic system show the most serious damage from the benzene, it is these structures that are chiefly concerned in the production of artificial precipitins and hemolysins. Weiskotton, Schwartz and Steensland (4) have done a great deal of work in this field, most of which has a bearing on the use of benzene as a therapeutic agent. However, one point which is valuable to the student of industrial poisoning is the effect of benzene in lighting up a latent infectious process. Four rabbits developed evidences of active acute infections in the course of daily injections of benzene, and in at least two it was apparent that these infections had existed in latent form before the injections were begun. In these animals there was no polymorphonuclear leucopenia following the benzene, and the animals died at the height of their leucocytosis with lesions in the organs characteristic of toxemia.

At the 1917 meeting of the American Association of Pathologists and Bacteriologists, Weiskotton reported experiments in the production of benzene leucopenia in rabbits by means of benzene vapors.

The instances in industry of benzene poisoning show that when exposure is excessive the effect on the central nervous system comes on with great rapidity, and a few minutes inhalation may be fatal. If the exposure is less great, there is time for an effect on the bone marrow and then multiple hemorrhages develop and the characteristic changes in the blood. I have records of men who were repairing pipes in benzene tanks or who were stopping leaks from benzene stills or simply watching defective benzene pumps, who succumbed so quickly to the effect of what did not seem to onlookers an excessive amount of the benzene, as to be fatally poisoned before help could come to them. One of these men was made to put on the usual Draeger helmet before he entered the tank. This helmet is so constructed as to prevent nose breathing by pinching the nose shut, the air that goes to the mouth being supplied by the pipe attached to the helmet. In spite of this protection the man fainted and when he was finally removed from the tank he was moribund. The only explanation the management could give was that the helmet had not entirely prevented him from breathing through his nose.

The susceptibility to benzene poisoning varies very much. In a coke by-products plant there was an overflow of benzene; two men who were working in the room fainted and fell to the floor, two others who went in to rescue them were likewise overcome and so were two more. After the six men had been laid out, there was a panic among the other workmen, but finally an Italian offered to go in saying that he never minded the fumes. He did go in, not even protected by a helmet and carried out the six, one by one, remaining apparently quite unaffected by his exposure.

The slower and more characteristic form of benzene poisoning with changes in the elements of the blood and with multiple hemorrhages was first described in this country by Selling (5) of Baltimore. His cases were young girls, fourteen years old, who had worked in a cannery where a solution of rubber in benzene was used to seal cans. Selling describes three cases, all with purpura hemorrhagica. The first of these, a girl of fourteen, had been at work for four months. She was brought to the hospital in a toxic stupor with purple spots on the skin and

hemorrhages from the gums and nose, and with a small weak pulse. After transfusion of blood she improved but the next day relapsed with rapid, labored respiration and weak and rapid pulse. Her temperature rose to 104.6°F. and her pulse to 165. The blood count just before death was 640,000 red cells, 600 white cells and hemoglobin, 8 per cent. Lymphocytes and large mononuclears made up 54 per cent. of the white cells. These cases of Selling's resembled very closely those described by Santesson (6) of Sweden in 1897.

Apparently this cannery near Baltimore has continued to use the same kind of sealing mixture for from time to time a case of benzene poisoning in a cannery worker comes to the Johns Hopkins Hospital. McClure (7) in 1916 published the history of a woman who was employed in this plant and who began to have obstinate nosebleed, then black and blue spots appeared over the body, followed by shortness of breath, bleeding from the gums and loss of appetite. This patient was given repeated transfusions of blood and eventually recovered, but at one point during her stay in the hospital the erythrocytes had fallen to 840,000 and the hemoglobin to 29 per cent. There is one mention of a white cell count of 1100. I have also notes of two cases treated in the hospital in the spring of 1918, one of them following a progressive downward course with bloody stools, bloody urine and hemorrhage into the ear. At autopsy, the marrow was examined and a note is made of erythroblastic hyperplasia and myeloblastic aplasia.

Dr. T. F. Harrington (8), Medical Deputy Commissioner of Labor of Massachusetts, has had some very striking cases of this same form of benzene poisoning in rubber workers. He describes five such cases in 1917, three of them being fatal. The men were all using rubber cement with benzene as a solvent for automobile tire building, applying the benzene to the rubber by means of a cloth. I will quote only the first of these five cases. This was a man who had worked for eleven months and had early begun to suffer from headaches. Then he noticed that his gums were spongy and bled readily; then spots, like bruises, appeared on his legs and arms and over his body. He became so weak and so breathless that he had to give up work. Two very severe nosebleeds sent him to the hospital. His pulse was 124 and weak; the hemoglobin was 60 per cent.; reds, 2,800,000; whites, 500. Transfusion of 10 ounces of blood was followed by uncontrollable nose-bleed and this recurred daily. He suffered from headaches, dizziness and restlessness, then became delirious, lost power in his arms and legs, sank into a coma in which he died after several convulsions. Before his death the hemoglobin had fallen to 35 per cent., the reds to 1,616,000, and the whites were 850, only 14 per cent. of which were polymorphonuclears.

BENZENE DERIVATIVES

The nitro and amido derivatives of benzene are used chiefly in the production of dyes, perfumes, drugs and explosives. Nitrobenzene is used in industry as the mono and the dinitro compound. The mono compound is liquid and is reduced by the action of iron filings and hydrochloric acid to aniline. It is also used as oil of mirbane in the making of cheap perfume. Dinitrobenzene is a solid. Before the war it was very largely used as an explosive in England and in Germany but not in the United States, so that we have not had experience in industrial poisoning from this compound. Accounts of it, however, fill the German and English literature. We use it chiefly as a dye intermediate.

The action of these benzene derivatives resembles that of benzene in that they act on the respiratory, vascular and heat regulating centers as benzene does, but they do not produce the same effect on the blood cells nor are capillary hemorrhages a symptom of nitro and amido poisoning. These compounds do not give rise to the extreme leucopenia which is a characteristic phenomenon of benzene poisoning. Methemoglobin is formed, and by some authorities all the clinical manifestations are to be explained by the air hunger caused by methemoglobinemia, but there is undoubtedly a direct action on the central nervous system as well. An early examination of the blood shows a polycythemia, though even then the hemoglobin may be low. Later there is great destruction of the reds and a profound anemia, with evidence of effort at regen-

eration of the reds, as seen by nucleated and megaloblastic forms. The blood is chocolate colored, and sometimes, not always, it is possible to detect the spectroscopic lines of methemoglobin. Hudson of the du Pont Company finds in men exposed to the nitro derivatives of benzene, a transient polymorphonuclear leucocytosis followed by lymphocytosis, which he looks on as evidence that absorption of the poison has reached the point where the man must be watched. He does not find this in aniline workers. Curschmann (9) of Germany emphasizes the importance of a rise in blood pressure and a hemoglobin loss of 15 per cent. or more, and Malden (10) of England looks for a stippling of the red cells as valuable a sign in aniline poisoning as it is in lead poisoning.

The dark or smoky color of the urine is noticed by the men themselves very early in their contact with aniline or nitrobenzene. Methemoglobin has been demonstrated, hematoporphyrin, hydrobilirubin, urobilin and bile pigments (11). Hemoglobin and also free blood have been found; albuminuria is not rare. A case of severe albuminuria following acute aniline poisoning was reported to me by Dr. Lippincott of Metuchen. In connection with the urine of workers with these aromatic compounds, one must remember the strange prevalence of bladder carcinoma among them as reported by the Germans among dye workers. Whatever the substance responsible, it seems to be an amido, not a nitro compound. Aniline workers, not nitrobenzene workers, have carcinoma of the bladder.

NITROBENZENE

The cases of industrial poisoning reported in this country are chiefly from the liquid mononitrobenzene in plants making aniline, and it is regarded by experienced men as distinctly more dangerous than aniline. There is not nearly so much poisoning from nitrobenzene as from aniline because the work does not involve so much exposure to nitrobenzene, but when it does occur, it is much more likely to have a fatal outcome, or if less serious, the disability lasts longer than in aniline poisoning.

An account of a serious case of nitrobenzene intoxication may be found in the records of the Massachusetts General Hospital for July, 1916. The patient, an elderly man, was at work in a soap factory, carrying a 5 gallon can of oil of mirbane. He seems to have spilt some of the fluid on his trousers, was noticed to grow rather shaky and then suddenly collapsed, spilling more of the fluid on himself. It is evident from the record that his mirbane-soaked clothing was not removed but that he was sent to the hospital as he was, so that it is no wonder that by the time he reached there his condition was serious. He was unconscious, breathing slowly and irregularly, but the heart was regular with good action. His pupils were small, irregular and did not react. The skin was of a dark gray-blue, anemic color. Some blood was withdrawn from the arm vein and it was chocolate colored. Respiration failed, becoming more irregular and shallow, but the heart action was good till just before death, which occurred one hour after he reached the hospital.

Absorption of nitrobenzene takes place usually, as in this instance, through the skin and of late this fact has become so well-known that in a well-managed plant, an accident, such as the above, would lead to the man's being promptly stripped of all his clothes, sponged off with weak acetic acid or vinegar and then given a full shower bath and made to put on clean clothes. The cases of poisoning from the solid dinitrobenzene are less rapid and severe. At least, I have so far not heard of a fatality. It is among the men especially who have to break up and shovel the solid dinitrobenzene in the crystallizing pans that the most trouble is experienced. Twenty-seven cases of poisoning were reported from one plant last summer and these did not include the milder cases. In another plant, the procedure was productive of so much poisoning among the men that they changed the method and, instead of crystallizing, let the molten compound run into water and granulate. In other places they heat the pan, melt the dinitrobenzene and let it run out.

A very curious history of slow, chronic intoxication with nitrobenzene was related by S. S. Adams (12) in 1912. The patient, a woman of middle age, used nitrobenzene as an ingredient for a cleansing fluid and for eighteen years she was more or less under Dr. Adams' observation. The

symptoms, which progressed very slowly, were those of a multiple neuritis, which finally resulted in contractures and almost complete powerlessness. She had extreme indigestion, even for the simplest foods, followed by emaciation, anemia, weakness and exhaustion. In the twelfth year of her illness she had several hemorrhages from the larynx and the pharynx, without evidence of tuberculous ulcers. The strangest part of the history is the recovery which came after a severe attack of erysipelas, with many abscesses. After these were healed the symptoms of nitrobenzene intoxication cleared up and except for a slight recurrence when she was again exposed for a while to nitrobenzene fumes, she remained well for the five years that had elapsed when Adams wrote his paper.

ANILINE

The symptoms of nitrobenzene poisoning are in all essentials like those of aniline poisoning and the two may be taken up together. A group of American cases of aniline poisoning were reported by Apfelbach (13) of Chicago, in 1913. These men were referred by factory inspectors to Apfelbach on account of the deep blue color of their lips and tongues. The symptoms of which they complained were slight, only headache, slight dizziness, and difficulty in swallowing. The first patient was a press feeder in a printing establishment who had been using a new sort of roller wash to remove the ink from the press rollers. This fluid was found on analysis in the state laboratory to contain aniline. There were no pronounced symptoms; the hemoglobin was over 100 per cent.; the red cells, 5,734,-000; and the spectroscope showed methemoglobin lines. The urine was a dark smoky color, but there was no albumin. In the second man, also, methemoglobin could be demonstrated in the blood, but otherwise the examination was quite negative, the only alarming symptom being the blue color of the man's skin and mucous membrane.

The next cases reported were by Birge (14) in 1914. The men in these cases were using aniline black paint, applying it with a brush and then washing the surface with hot water and soap suds—work which naturally made skin absorption easy. The patients were seized with nausea, general weakness, palpitation of the heart, then violent headaches with vomiting. The urine in each case was dark colored, the skin very pale, the lips blue. In 1915, Hayhurst (15) in the course of his survey of the state of Ohio found cases of aniline poisoning in the rubber works and in users of a certain roller wash in printing shops. Aniline had recently been introduced into this industry as an accelerator of vulcanization and in the early days of its use, in 1914, the cases were sometimes very severe.

Dr. R. V. Luce of Akron, Ohio, helped me in a study of aniline poisoning in that city. We found records of coma lasting sixteen, twenty-two, twenty-four and twenty-six hours, though we heard of only one case that proved fatal. In the report of our findings (16), we quoted von Jaksch to the effect that pure aniline is not poisonous and that what is used in industry as aniline is a mixture of meta-, para-, and ortho-toluidine and xylidines. Just lately I have seen this statement repeated, but it is quite erroneous. Chemically pure aniline produces all the symptoms and blood changes that we know to be characteristic of industrial anilism, and I cannot think what von Jaksch meant by his statement. Certainly the experiments of K. B. Lehmann (17) show that pure aniline is very toxic in even smaller quantities than carbon disulphide.

When aniline was first used in American industry we all supposed that the fumes were the danger, not absorption through the skin. A victim who had turned blue in the face and had begun to stagger was taken at once to the fresh air, but we did not realize then that what he needed was to bathe and get rid of the aniline on his skin. It was probably because of this error that the early days of dye manufacture were marked by some severe cases of poisoning in men who had their hands in aniline or its derivatives, or who were working in an atmosphere of dust from screening or barrel packing, or who had splashed a liquid over their clothes.

A case recorded in a Brooklyn hospital was one of the earliest in our literature, and so unfamiliar was the condition to physicians at that time, hardly more than two years ago, that the doctor sum-

moned to the plant where the man lay on the floor in a faint, thought he must surely have fallen into a vat of dye, he was such a deep purple color. This man had been scooping up aniline and had probably spilled it over himself. At the end of about seven hours' work he began to feel twitching in the toes and feet, spreading up the legs, then nausea and faintness. He was made to sit down in the open air for a while but did not wash his hands or change his clothes. He grew weaker, lost consciousness, because deeply cyanosed and his heart was rapid and weak. Almost three weeks later, when interviewed by the physician of the Factory Inspection Service, he was somewhat dazed and unable to collect his thoughts and was too weak to go back to work.

The foreman of a plant in New Jersey who was experimenting with aniline and had his hands in it a good deal of the time, is one of the few cases of fatal poisoning of which we have records. I visited the plant soon after this occurrence and found the ventilation in this department ample, so that fumes could not have played a part in this case. The fellow-workers of this man reported that he never washed his hands upon leaving the plant. He came to work one morning complaining of headache and was advised to go home, but he stayed until noon when he left and, by the time he reached home, was so ill that a doctor was summoned. By one o'clock, he was deeply cyanosed, vomiting yellow frothy material, and his pulse was weak. His doctor did not realize that his condition was serious, but twenty minutes after the doctor had left the patient had a convulsion and, at three, the doctor returned to find the patient unconscious with a very weak heart. He had a second convulsion and the heart action grew steadily weaker till the early morning, when he died. This delayed action of the poison is characteristic of all the members of this group. A man is much more likely to be overcome some hours after he has left the plant than while he is at work.

The rubber industry used to be the greatest source of aniline poisoning, but the growth of the dye industry has displaced it. Moreover aniline is not now used as much in rubber compounding as it was. Instead, aniline-formaldehyde is being substituted, and this is a solid and apparently does not give rise to industrial poisoning. Another substitute is hexamethylenetetramine (urotropin), formed by the action of ammonia and formaldehyde. This, I am informed, has caused some trouble among the men who compound the rubber, but I have been given no details and can only say that it seems hardly likely that any serious trouble could be caused by handling hexamethylenetetramine.

DYE MANUFACTURE

The making of dyes has necessitated the production and use, not only of benzene, nitrobenzene and aniline, but also of an enormous number of derivatives, many of which have a toxic action on the skin, on the central nervous system, or on the blood, or on all three. The chemistry of the dye industry is of a bewildering complexity, and I must not attempt here to go into it in detail, if indeed I were sure of my ability to do so. The compounds used belong to the coal-tar series chiefly. The starting points for the dyes are benzene, toluene, xylene, phenol, naphthalene, anthracene, phenanthrene, and carbazol, all of them being formed on the benzene ring. The first four are decidedly toxic. Naphthalene is very slightly so, the others are apparently inert. Other compounds belong to the fatty series: alcohols, especially methyl and ethyl; the chlorides of ethyl and methyl; formaldehyde; dimethyl sulphate. The heavy acids (hydrochloric, nitric and sulphuric), the alkalis (of which caustic soda is the most important), and certain oxidizing agents (such as lead oxide and potassium bichromate) and reducing agents (such as hydrogen sulphide) are the most important inorganic compounds used.

The toxicity of the benzene derivatives depends partly on their physical properties, whether solid or liquid, volatile or non-volatile. Their toxicity can be partly gauged by their chemical constitution, but only partly. The entrance of chlorine into a fatty compound increases the poisonousness (for example, chloroform is more poisonous than methane), but the benzene series are little, if at all, affected by the entrance of chlorine. Nitration of a product increases decidedly its toxicity; nitrobenzene and nitrochlorbenzene are much more toxic than benzene and chlor-

benzene. Sulphonation (the introduction of the HSO_3 group) renders a compound non-toxic; as soon as aniline is sulphonated it ceases to give any trouble. The introduction of the COOH groups lessens toxicity. Take, for example, salicylic acid as compared with phenol. The introduction of an alkyl group, methyl or ethyl, lessens toxicity; dimethylaniline is less toxic than aniline. The HO group makes the members of the benzene series more poisonous (pyrogallol with three HO groups is more poisonous than phenol with one), while the alcohols are changed to harmless glycols and glycerol.

I shall not attempt to describe the making of the dyes in detail, but only to speak briefly of the different classes of dyes and the dangers connected with each. The azo dyes are probably the safest to make, for though they start with aniline or with one of the toluidines, or toluylendiamine, they do not require the use of large quantities of these bodies, the reactions take place at the freezing point, and the risk of fumes is nil. Sometimes benzidine is the starting point, and this, though closely allied to aniline, is a solid and so far as I know does not cause poisoning. The alizarin dyes start with anthracene, and in oxidizing this substance to anthraquinone potassium bichromate is used, and chronic ulcers are not infrequent among the men in this department. Otherwise, the manufacture of these dyes is fairly safe. The making of indigo requires the action of monochloracetic acid, a powerful caustic, on aniline. In the only indigo factory I have visited, the aniline is made by nitration and then reduction of the monochlorbenzene which the factory produces in large quantities in the course of other manufacture. Consequently, there are here many opportunities for industrial poisoning.

The arylmethane dyes are a very large class, including the malachite green series and the rosaniline-fuchsin series. For these, large quantities of aniline and of para-toluidine are used and also ethyl and methyl anilines and aniline hydrochloride and benzyl chloride. The same is true of the pyrone dyes, to which the eosins belong and the fluoresceins, and the azine and oxyazine dyes of which nigrosin is the best known example. The industrial intoxications that occur in this class of work are from aniline and the toluidines or from their alkyl derivatives, or from aniline hydrochloride or dimethyl sulphate. There are also instances of chlorine poisoning, especially in the manufacture of nigrosin.

The nitro and nitroso dyes are in themselves poisonous and their manufacture involves the danger of burns from nitric acid and poisoning from nitrous oxide fumes. The best known of these dyes are picric acid, or trinitrophenol, and Martius yellow, or dinitronaphthol, and aurantia, or hexanitrodiphenylamine. Finally, the making of sulphur dyes, sulphur yellows, browns, khaki, black and blue, is the most dangerous branch of the dye industry. The intermediates used are benzene, aniline or phenol, and a large number of derivatives, both nitro and chlor compounds, all of which produce a more or less severe dermatitis and the characteristic effects on the central nervous system and the blood of the aniline and nitrobenzene derivatives. In addition, the making of sulphur dyes involves the danger of hydrogen sulphide poisoning.

It is impossible to give more than this brief outline of the way in which dyes are made, for if I attempted more I should get into hopeless complications. I will give a few instances of the reactions involved. Malachite green is made by what is known as a condensation process, which consists in the union of two compounds into a new one by the loss of water or hydrochloric acid. Benzaldehyde and dimethylaniline are mixed for this purpose with a condensing agent, such as zinc chloride, and heated. One molecule of water is split off, the oxygen of the benzaldehyde uniting with two hydrogen atoms from the two molecules of dimethylaniline, and a compound is formed which is tetramethyl-diamino-triphenylmethane. These are really comparatively simple processes in dye manufacture. Sulphur blue is more complicated. For this, benzene is chlorinated, then nitrated, the para-nitro-chlorbenzene is fused with caustic soda to form para-nitrophenol. This is reduced by means of iron filings and hydrochloric acid to paramidophenol, which is then acted on by dinitrochlorbenzene to form dinitro-dioxy-phenylamine, which with sodium sulphide, yields sulphur blue. So far as I know every one of

those compounds is toxic.

Certain factories in the United States make only the dye intermediates. For instance, benzidine sulphate is made by the action of zinc, hydrochloric acid and sulphuric acid on nitro-benzene. The famous Congo red for which there is a large demand in the Orient, is formed when benzidine sulphate is used together with naphthionic acid. This last is made by the action of sulphuric acid on alpha-naphthylamine, in the course of which manufacture very serious poisoning has resulted.

There are also several factories manufacturing para-nitraniline, which is one of the intermediates for sulphur dyes and is also used with beta-naphthol, forming on the fabric the bright red known as German para red. Another important intermediate is the so-called H acid, the chemical name of which is amido-naphtho-disulphonic acid. At one stage in its manufacture nitroso-beta-naphthol is formed, and contact with this causes a severe dermatitis which in one New Jersey town is known as "nitroso itch." Michler's ketone is, chemically, tetramethyl-diaminobenzophenone. It is an important intermediate for dyes such as crystal violet and auramin, and is made by the action of phosgene on dimethylaniline.

One must also take into consideration the use of the heavy acids and the possibility of poisoning from the acids themselves or their anhydrides. The effect of inhaling nitrogen oxides is much more familiar to us now than a few years ago, because, in the manufacture of explosives, this is the form of poisoning that gives the most trouble and causes the greatest mortality. An industrial case of nitrogen oxide poisoning is, clinically, practically the same as a case of chlorine gassing from the trenches. It is not often that fumes of nitrogen oxides constitute a serious danger in dye manufacture. I was told of rather an unusual case not long ago which, though connected with color manufacture, had nothing to do with aniline dyes. A man was grinding chrome green. In some way an iron nail fell into the grinder and a spark ignited the mixture. The head of the factory fire department entered the room wearing a respirator and remained only a few minutes. He went home without realizing that he was injured in any way, ate his dinner and went to bed, but in a few hours awoke with violent abdominal pain and acute air hunger. This increased as edema of the lungs came on rapidly and he died at 5 o'clock in the morning, less than fifteen hours after the accident. This case is typical of industrial nitrous fume poisoning.

Of the fumes from sulphuric acid, I have always supposed that sulphur dioxide was the most harmful. Managers and foremen insist that it is harmless after a man has grown accustomed to the first irritating effects on eyes, nose and throat. Apparently, it is one of the gases which the Germans contemplated using in gas warfare, and according to Lehmann, the effects begin to be apparent when it is present in 0.003 per cent. concentration in the air. Sulphur trioxide is very avid of water, forming sulphuric acid immediately, and the stinging sensation one has on the face and in the throat when in contact with sulphur trioxide is doubtless caused by the formation of this acid. Chlorine gas is given off, especially in the making of benzyl chloride and nigrosin. I have the history of a case of serious sickness in a man who was manufacturing benzyl chloride by passing chlorine gas into pure toluene. His symptoms were: cyanotic color, nervousness, excessive insomnia, fogginess of vision, pain in the region of the liver, and loss of some 25 pounds in weight. It is, of course, impossible to say from which of these poisons—toluene, chlorine or benzyl chloride —he was suffering, or whether it was not a mixed case. Benzyl chloride has, to a lesser extent, the effect on the eyes produced by benzyl bromide which was, we are told, one of the lacrymatory gases used by the Germans.

Finally, I must mention the dangers from caustic soda, which is a very important compound in certain kinds of dye manufacture. In well-managed plants this is handled with great care, and the men who work with it are required to protect their eyes with goggles. In other places I have seen it used with great carelessness, yet a splash in the eye may result in the loss of the eye. Few industrial accidents are more distressing than the blowing up of an autoclave in which caustic fusion is going on, for the scattering of the caustic causes terrible burns.

The cases I shall cite, in illustration of industrial poisoning in this trade, are all from American sources. Indeed, everything I have said about the industry is what I have learned in American plants. Although one cannot get on without the German literature in the study of aniline dye manufacture, still it is never safe to assume that what is done in a German factory, is done in the same way in an American factory.

There is no need to describe further the symptoms of aniline poisoning, but I should like to give a few instances showing the way in which industrial cases occur. A man took off his shoes to save them, and worked in his stocking feet, and as the floor was damp with aniline and water, he became poisoned. A man sat on the top of a barrel to eat his lunch. A little aniline had collected on the top of the barrel, it soaked through his trousers and he absorbed enough to make him sick for five days. Two men were cleaning from an aniline reducer what is called the sludge, i. e., the iron filings used in reduction of nitrobenzene to aniline. One of them worked with bare hands, the other wore canvas gloves but got them soaked. Both were poisoned, but the one with gloves much more seriously. The owner of the dye factory told me that the most serious case they had had was in a man wearing long rubber gloves, who was filling drums with aniline. He let a little aniline run down on the inside of one glove and as he went on working in what was really an aniline poultice, he became very seriously poisoned. Another case that almost ended fatally, was that of a man who tried to mop up aniline from the floor. He got his clothing saturated and fainted, falling with his head on the aniline-soaked floor, where he lay unconscious for an hour before he was discovered. He did not regain consciousness for fully twenty-four hours and was sick for two weeks.

That aniline fumes alone can cause symptoms of poisoning seems beyond doubt. Chemists and foremen who are not in direct contact with fluid may show all the symptoms of anilism, and it is a common experience of workmen that in hot, heavy weather, especially on the night shift, there is always a decided increase in headaches and dizziness and cyanosis. One case of this type of poisoning occurred in a Brooklyn plant. A man was working on the night shift in the dye works and at 10:30 P. M. he climbed a ladder to inspect a vat of dye in process of making. He lifted the lid, inhaled the fumes, and in a few minutes lost consciousness and did not wake till the next morning. He was under treatment in the hospital for a week. The compound in the vat was dimethyl-aniline.

As for poisoning through swallowing, I have the record of only one case, a chemist who was trying to syphon aniline from one drum to another and drew a mouthful into his mouth. He thought he did not swallow any but he at once rinsed out his mouth with dilute acid. After an hour he began to feel weak and languid and went out and lay down on the grass. There he became pleasurably intoxicated, felt perfectly happy and began to sing, but could not be persuaded to move until the doctor came and insisted on his going into the house. On the way, he lost consciousness for a few minutes and fell to the ground. His heart was alarmingly weak, his lips and mouth were a deep blue. The next day he felt as if he were recovering from a hard spree, and for days after he was so weak and languid that he could do nothing but lie in a hammock. His urine was chocolate colored, and after that whenever he came in contact with aniline he would notice a darker color in his urine.

There are a number of compounds with an action similar to that of aniline, some more intense, some less so. Some of these compounds are unfamiliar to the ordinary physician and he is at a loss when he finds obscure illnesses resulting from work with them. For instance, alpha-naphthylamine, the amido derivative of naphthalene as aniline is of benzene, is capable of causing the same, if not more serious damage than aniline. One of Apfelbach's early cases of industrial cyanosis was caused by fumes of this substance.

Usually the symptom complained of most by men working in para-nitraniline is a very painful and itching skin eruption. This is true also of the men who handle dinitrochlorbenzene, made in large quantities for sulphur dyes, and para-phenylene-diamine which is not an intermediate but is used under the name of

ursol as a dye for furs. It is probably really an advantage to the men that this skin eruption occurs, for while workmen will tolerate quite serious systemic symptoms for a long time they will not endure burning and itching of the skin and it usually makes them quit the job. The result is that the management is faced with a shortage of labor which may make operation impossible, and there is nothing for it but to protect the men against the irritating dust, incidentally protecting them against systemic poisoning as well. I know of one factory in which the paranitraniline men are furnished a full set of clean underwear, a pair of socks, a clean suit of overalls, a clean canvas cap, and clean canvas gloves every morning on going to work. At the end of the day's work, or immediately after an unusually dusty job, they are obliged to take a full shower bath and change into other clothes. This sounds like an expensive method, but the management has found that it pays.

Meta-nitraniline was manufactured rather largely during the war, partly for use as an intermediate for khaki dyes, partly for the making of a new explosive, tetranitraniline. Very little, if any, seems to be made now. The German authorities consider this isomer less poisonous than the para, but experiments made by Dr. Lewis in the Sprague Memorial Institute show that the meta is more poisonous to animals. There was a great deal of industrial poisoning from meta-nitraniline in the ordnance plant that manufactured it last summer, the most dangerous work apparently being at the screens and at the filter press and cooling tubs where, according to the management, the fumes were a source of trouble. I should be inclined to think that the men had got their hands wet and absorbed the paste through the skin. Dinitrobenzene was manufactured in this same plant, but, strange to say, the poisoning from meta-nitraniline, though slower in developing, caused a longer period of disability than the dinitrobenzene.

Aniline hydrochloride is commonly known as aniline salt. It is made and used in large quantities and is recognized in the industry as a poison. It is the substance that was used by Price-Jones and Boycott of England in their experiments on blood changes in aniline poisoning. They succeeded by the use of this compound in reducing the hemoglobin in rabbits to 50 per cent. Microscopically they found basophilic nucleated red forms and megaloblasts. In 1898, Veasey (18) described a case of failing sight in a dyer who was working with what he called aniline salts. The man was suffering from a low grade optic neuritis, and after removal from the fumes, his sight improved decidedly. I do not know whether in this case aniline hydrochloride was the salt used. I am inclined to believe that it was aniline black, in which case pure aniline fumes would be given off.

Mono and dinitrophenols are important intermediates. There were three cases of acute poisoning and death in an American factory last summer where men were handling dry dinitrophenol in the course of manufacturing picric acid by the French method, which differs from ours in not having phenol as an intermediate stage. These cases resembled the ones described by Etienne Martin and M. Guerbet (19) last summer. The French had a great deal of dinitrophenol poisoning in their munition industry and they describe a typical case as follows. The sweat is yellow and this, not on the hands and face, but on the covered parts of the body, showing that it is really an excretion. There is great lassitude and a feeling of constriction around the chest which interferes with breathing. Cyanosis is slight; the heart is unaffected. As the case progresses, there are nervous tremors, sweating, with intense thirst, and then a sudden rapid rise of temperature to 104° F. or over, followed by symptoms of uremia with convulsions, coma and death. At autopsy there may be edema of the lungs, but the other organs show nothing characteristic.

Another case of fatal poisoning from dinitrophenol was reported by Dr. A. S. Warthin (20) of Ann Arbor in 1918. Dr. Warthin did not see the patient, but the urine and liver were sent to him for examination. He found the former a dark yellowish-red, slightly smoky but with a definite greenish coloration, containing a trace of albumin, and abundance of bile pigment. The tests for phenol derivatives, both dinitro and trinitro, were strongly positive. The liver was grass-

green, icteric, capsule shrunken, lobules small. Under the microscope the picture was that of a very acute degenerative hepatitis, such as is found in acute yellow atrophy and after poisoning by chloroform, trinitrotoluene or tetrachlorethane.

The alkyl derivatives of aniline are not as toxic as aniline itself. Cases of poisoning from dimethylaniline which have reached the hospital have usually resulted from an indefensible, excessive exposure. For instance, a man whose case was described by Dr. Lester Roos of the New York State Department of Labor was set to bailing dimethylaniline from one tank to another and worked at this for five hours, probably getting it over his hands and clothing, as well as inhaling the fumes. He was "knocked out," as he said, but felt better after he got into the open air, and was then allowed to go home. He was wearing his working clothes and after he reached home he became dizzy and lost consciousness. He was taken to the King's County Hospital, deeply cyanosed. It was possible to demonstrate methemoglobin in his blood.

In connection with dimethylaniline, mention must be made of a very dangerous poison which is sometimes used in its preparation. This is dimethyl sulphate. Why this substance should be so toxic is not clear to me, but it is known to be so by German dye manufacturers and I find that chemists in this country consider it to be the most dangerous substance they have to deal with, except phosgene and perhaps sulphuretted hydrogen. No cases of industrial poisoning from it have come to my knowledge, but that they have occurred in some of our plants is very evident from the respectful attitude maintained toward it. It is not necessary to use dimethyl sulphate to introduce the methyl group, but it is a cheap way of doing so. If methyl chloride or alcohol is used, the reaction must be carried on with heat and pressure in an autoclave, while dimethyl sulphate will do the same thing without heat and pressure.

Sulphuretted hydrogen is, as I have already said, used as a reduction agent in the making of sulphur dyes. It is poisonous in very small quantities. Danger to life begins when the quantity has reached 0.7—0.8:1000 parts of air, and a proportion of 1.0—1.5:1000 is rapidly fatal. According to Cushny (21), poisoning is due in part to a local irritant action and in part to a direct action on the central nervous system. In severe cases the latter results in sudden unconsciousness before the irritant effect on throat and lungs is noticed. In the making of sulphur browns, especially, great precautions are taken to prevent the escape of this gas which is dreaded by all foremen. If there is a leak, the effect on the men is almost instantaneous. In one plant, six men were overcome in one night and all had to be carried out. I have been told of several cases of fatal poisoning during the past year, but have not been able to secure any histories. Superintendents recognize that there is an increasing susceptibility to hydrogen sulphide poisoning, and in one well-managed factory a man who has once suffered from the effects is not allowed to return to that department. In this connection, I should like to mention an unusual case of industrial poisoning from hydrogen sulphide which was reported by Canby Robinson (22) of St. Louis in 1916. The patient was not engaged in dye manufacture, he was working in a chemical factory at a tank where hydrogen sulphide was being passed through a copper sulphate solution. He was overcome and fell unconscious to the floor. By the time he reached the hospital, he was conscious though somewhat dazed. The symptom which interested Dr. Robinson especially was a typical, transient auricular fibrillation, which lasted for several hours.

I must not close the description of the substances used in making aniline dyes without mentioning phosgene. It is so familiar to us all, because of its use in gas warfare, that I need not say more about it than that it is an important substance used in the production of Michler's ketone, an intermediate for several dyes. There have already been deaths from phosgene gas among workmen, at least three, possibly five. Two occurred in 1917, before the nature of the gas was well known. It is interesting to note that the industrial cases give the same history of the disastrous effects of muscular exercise after inhaling the gas that we are familiar with among soldiers. An accident which liberated a fairly large quantity of this gas caused poisoning in sev-

eral workmen but all of them were promptly cared for and recovered. An Italian teamster who was outside of the building where the accident occurred, was not known to have inhaled the fumes and was allowed to go on with his work and then go home. He died shortly after reaching home.

There are some compounds used in dye making about which one can make a guess from their chemical composition, though nothing definite is to be found in the literature or to be learned from interviewing practical men. Such an one is nitrosodimethylaniline, and also ethyl and methyl alpha-naphthylamine. Formaldehyde is used in making dyes, and also in other industrial processes. We know very well the irritating effect of the vapors of formaldehyde on the respiratory mucosa and also that certain persons have an idiosyncrasy to it and cannot come in contact with the solution without getting a dermatitis. It is manufactured in Perth Amboy and physicians there are very familiar with bronchitis and even broncho-pneumonia from formaldehyde fumes. In the same factory formaldehyde is combined with phenol to form bakelite, a substance much like hard rubber and used for the same purposes.

Bakelite itch is a commonplace disease in Perth Amboy but I know of no other trouble caused by it. I have already spoken of the manufacture of ammonia-formaldehyde or "urotropin" for rubber compounding. Redmanol, which is phenol-ammonia-formaldehyde, is manufactured in the same place.

Lastly, I want to speak of an interesting report that came to me last summer about calcium cyanamide, resulting from the fixation of atmospheric nitrogen by lime. This substance was made at Niagara Falls and was used as a source of nitrogen in a large trinitrotoluene plant. It is a black impalpable powder, excessively irritating to the skin, so much so that the men who unpacked it were made to bathe at the end of four hours' work and then were shifted every four days. The dermatitis was severe, the substance eating into the skin as unslaked lime does. Sometimes abscesses resulted or sever cellulitis. The physician who described this to me told me that he had never seen any systemic effects, except when a man drank alcohol and then, even if the amount were very small, he would have profound vasomotor symptoms with flushing, sweating, headache, ringing in the ears, and increased heart action. These symptoms would disappear after twenty-four to forty-eight hours. Only once did he see dyspnea in a man who had not been drinking. Once the symptoms came on after a dose of paregoric which was taken for diarrhea.

Soon after hearing this tale, I found the following account in the *Bulletin de l'Académie de médecine* of Paris for July 9, 1918, by J. P. Langlois. He says that workers on calcium cyanamide are likely to have dermatitis and burns, from the lime and the high temperatures to which the calcium carbide has to be raised to make it combine with the nitrogen. But these men are evidently manufacturing it, not handling the product, as the American workmen were doing. However, Langlois has noted the same peculiar reaction to alcohol that Dr. H. E. Lampton of Barksdale had described to me. He says that it is seriously dangerous for such men to drink alcohol, that even a glass of wine will make the pulse go up to 104 and the blood pressure fall to an extremely low point, with rapid respiration. In a typical case, the patient had syncope after drinking 30 c.c. of red wine. The fainting returned whenever he attempted to raise his head, he was nauseated, his face much flushed, and his eyes injected. The blood pressure was low for an hour, but by the end of the eighteenth hour his condition was normal again. Langlois has confirmed on animals this sensitization of the vasodilator system by calcium cyanamide, which is of such a character that a dose of alcohol is enough to make the blood pressure fall. Here we have two almost identical observations made quite independently, one in France and one in northern Wisconsin.

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BOOK REVIEWS

The Six-Hour Day, and Other Industrial Questions. By Lord Leverhulme. Edited by Stanley Unwin. Cloth. Pp. 341 and index. New York: Henry Holt & Company, 1919.

The question of the proper payment, administration, and conduct of labor is justly receiving a great deal of attention at the present time. In fact, the labor question is conceded by practically everyone to be a major problem of the reconstruction period. Much that we hear concerning this great problem comes from the leaders of the labor unions and the authorities on labor questions; it is seldom that a man of standing and experience in the business world who has gained his experience at first hand comes to the front with a statement of his experiences, observations and conclusions regarding labor. It is for this reason that we are fortunate in having in collected form the addresses and essays of Lord Leverhulme, a successful business man who has had first-hand contact with labor for many years.

Lord Leverhulme began his business career at the age of sixteen when he entered his father's grocery store in Bolton. Since that time (1867) he has been actively engaged in business and is now chairman of the firm of Lever Brothers, Limited, soap manufacturers of Port Sunlight.

The book which consists of 27 lectures and essays is divided into five main parts: "The Six-Hour Day," "Co-partnership," "Housing and Social Welfare," "Education and Business," and lastly a miscellaneous collection of lectures entitled "Some Industrial Questions."

It is the author's opinion that the greater portion of humanity is overworked, that the extent of its education is too limited (because of the necessity of entering industrial life at too early an age), and that it suffers greatly by living under crowded conditions. The greater part of the book is concerned with the means for making the most of our supply of humanity, namely, remedying the above faults or ill conditions.

The reports of Vernon (Health of Munition Workers) are cited as proving that the length of the present work day is such as to produce an undue amount of fatigue, an amount which may result in an actual diminution in the rate of hourly production. The author advocates the adoption of the six-hour work day on the basis of these fatigue studies, and suggests the operation of industrial plants in two or three shifts so as to meet the demand for increased quantities of goods. It is not to be disputed that in many occupations fatigue is excessive, but at present we cannot deny the fact that our knowledge of industrial fatigue is very limited; in fact, the reports cited by the author are held by many not to show clearly that after six hours of labor, fatigue becomes excessive or that the hourly rate of production begins to decrease. The author tries to show by means of an example that the unit cost of production would change very little with a change from a forty-eight-hour week to a seventy-two-hour week (two thirty-six-hour shifts) even though the worker were paid the same for six hours work as formerly for eight. It is to be pointed out in the example cited that with this change the direct labor cost of each unit of production would be £1.33 under the new condition as compared with £1.0 under the forty-eight-hour week, and that a portion of the overhead charge caused by power consumption by machinery would increase in direct proportion to the increase in hours of labor and not remain stationary as the author suggests. It would also be necessary to add a charge for the use of artificial light and some additional charge for managerial services (foremen and night superintendents). It would seem that assuming the conditions of the problem as cited by the author, the cost of a unit of production would certainly increase—by just how much it is impossible to state. It is however true that operating a plant for two or three shifts would tend greatly to cut down the cost of production due to overhead charge, but here the author has overlooked a rather important point, namely, the valid objections to night work.

In order to decrease waste and increase quality and quantity of production, the author suggests the adoption of the co-partnership plan. According to this plan the worker is to receive a share of the profits of the concern; but because he does not share any losses he is not to be allowed to exercise any jurisdiction in the management of the enterprise. On the other hand, the fact that he is a co-partner shall not be reason for paying him any less than union scale wage. The author's co-partnership plan has worked out successfully in the plant of Lever Brothers, and the system in use today is the result of over 20 years of experimentation in the methods of rewarding labor for its zeal in promoting the interests and profits of the industry.

Lord Leverhulme's utterances on the subject of co-partnership are highly illuminating and are to be regarded as authoritative on this subject; his plan is, to say the least, an excellent and practical one; perhaps no one man is more capable or has had more experience along these lines than he.

The educational scheme suggested by the author is simply the use of the two hours released by the shortening of the workday for educational purposes. The education of the worker would start at fourteen years and end at thirty. In this period of sixteen years the daily education would be compulsory.

The living conditions of the laboring class have made a profound impression upon Lord Leverhulme. He feels that by proper apportionment of land we can alter the living conditions and so produce a healthier race stock. Many statistics are cited which show the beneficial effect of proper housing and living conditions. Lord Leverhulme's plan here is to distribute land at the outlying portions of the city free to the laboring classes. He reasons further with the object of showing that this scheme would work

out to be self-supporting. In this portion of the work it must be pointed out, however, that there is again a fallacy in the author's reasoning, where he tries to show (p. 160) that the effect of overcrowding *per se* produces a high death rate. Obviously, he has failed to take into consideration several variables existing between the two conditions cited. An important one, for instance, would be occupation. But it cannot be gainsaid that proper living and housing conditions are conducive to mental and physical health and comfort, and that a well-ordered, carefully worked out plan for housing is of great assistance in helping humanity to press forward and develop to its utmost. Lord Leverhulme possesses a remarkably thorough knowledge of all the fine points of the housing problem.

In the last section of the work entitled "Some Industrial Questions" the author discusses in a general way some of our industrial problems, as day work or piece work, the relations existing between labor, capital, and the employer, and again, the six-hour-day and co-partnership.

Lord Leverhulme has written a most interesting and enlightening book, not from the point of view of the reformer or the labor leader, but from that of the business man. His driving object is to make the world a more liveable place for all; an end which he feels can be attained without the sacrifice by laborer, capitalist, or employer of any of their rights or privileges, but rather by the co-operation of these three to the fullest extent. His thorough understanding of the fundamentals of this great problem and his practical co-operative and not philanthropic views cannot but make this volume appreciated by those who are seeking light on this most important question.—*Leonard Greenburg.*

Organization in Accident Prevention. Sidney Whitmore Ashe, B.S., E.E., Head, Educational and Welfare Department, Pittsfield Plant of the General Electric Company. New York: McGraw-Hill Company, 1917.

This small volume of 120 pages gives a simple, non-technical summary of the methods used by one large concern in attempting to control its accident frequency. It seems to be quite unevenly balanced, giving undue emphasis to the less important methods, at the expense of some of much greater value. More than five times as much space is given to the Prone Method of Resuscitation than is allotted to Education in Accident Prevention.

The writer presents few of the reasonable arguments for physical examination of employees. The charts used throughout the volume are in particular open to criticism.

However, much of the book is very commendable. It is entertaining and should be stimulating to employers who are new in the field of accident prevention.—*Chas. F. Horan.*

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Municipal Housecleaning. The Methods and Experiences of American Cities in Collecting and Disposing of Their Municipal Wastes—Ashes, Rubbish, Garbage, Manure, Sewage, and Street Refuse. By William Parr Capes, Director, New York State Bureau of Municipal Information, Secretary New York State Conference of Mayors and Other City Officials, and Jeanne Daniels Carpenter, A.M., LL.B., Expert in Economics and Municipal Research, Boston University. With an Introduction by Cornelius F. Burns, President of New York State Conference of Mayors and Other City Officials. Cloth. Pp. 232. New York: E. P. Dutton & Company, 1918.

Geriatrics. A Treatise on Senile Conditions, Diseases of Advanced Life, and Care of the Aged. By Malford W. Thewlis, M.D., Associate Editor, Medical Review of Reviews, New York City. With Introductions by A. Jacobi, M.D., LL.D., and I. L. Nascher, M.D. Pp. 250, with illustrations. St. Louis: C. V. Mosby Company, 1919.

Symptoms of Visceral Disease. A Study of the Vegetative Nervous System in its Relationship to Clinical Medicine. By Francis Marion Pottenger, A.M., M.D., LL.D., F.A.C.P., Medical Director, Pottenger Sanatorium for Diseases of the Lungs and Throat, Monrovia, California; Professor of Diseases of the Chest, College of Physicians and Surgeons, Medical Department, University of Southern California, Los Angeles, California. Cloth. Pp. 328, with illustrations. St. Louis: C. V. Mosby Company, 1919.

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TOXEMIC ANEMIA FROM ARSENIURETTED HYDROGEN GAS IN SUBMARINES*

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ON June 15, 1916, three men from submarine D.4 were admitted to the Royal Naval Hospital, Chatham, as cases of poisoning by carbonic oxide or carbon dioxide. An examination of these men's blood showed they had suffered an enormous destruction of the red cells. This condition was obviously not due to carbonic oxide or carbon dioxide, but did suggest the presence of an extremely toxic gaseous poison in the air of the submarine. I therefore reported the condition found, submitted it would be advisable to search for the cause in the boat, and that other members of the crew should be examined to see if they were suffering from a similar condition. Clinically, the cases were those of poisoning by arseniuretted hydrogen gas, and the urine, hair, finger and toe nails of some of the cases contained arsenic.

Submarine D.4 did two trips in which symptoms occurred. The first trip started May 16, 1916; she was absent seven days, submerged seventeen hours daily, and returned to her base on May 24th. The second trip started on June 3d; she was only away four days when she had to return on June 8th; the average time she was submerged was also seventeen hours daily.

D.3 did three trips during which toxic symptoms developed. The first was in February, 1916, and lasted eight days, the boat being submerged about the same time as on the other trips. The second trip started on June 19th and ended June 27th,—eight days, with eighteen hours' diving a day. The third trip, commencing on July 21st and finishing on July 23d, was experimental in nature, as the commanding officer of the boat had orders to return if symptoms occurred. On his return the commanding officer stated that the first symptoms started at the eighth hour of the dive, the vomiting at the 14th hour, and at the 18th hour the submarine broke surface. Within twenty minutes, twenty of the crew of twenty-six had vomited, fresh hands and men who had been in the boat on the previous trips being equally affected. This third trip of D.3 conclusively proved the batteries to be the source of the gas. All the men I interrogated put their symptoms down to an evil smelling new fuel; but as this trip was undertaken with fresh fuel but with the same battery, the fuel must be exonerated from all blame. In addition, since D.3 has been fitted with new batteries she has dived without any untoward symptoms among the crew. In the first trips of both boats the symptoms were not so marked as in the second trips, and the crew were well enough to carry on duty or to proceed on leave on their return. The weather had been very bad and the vomiting was attributed to it, in spite of the fact that many men affected had been in the submarine service for years, and had never been seasick in their lives. (It should be noted that two men from D.3 were sent to the hospital after the first trip, but their condition was not diagnosed.)

In all, thirty cases have been admitted from these two boats, fifteen from each.

*Received for publication April 22, 1919

With the exception of three cases (Nos. 16, 17, and 18), none were seen till five days or more had elapsed after the return of their submarine; hence, in making this report, one has to depend a good deal on the histories given by the men and on the hospital case sheets rather than on the signs and symptoms evident on admission. However, these submarine ratings, being doubly picked men of above average intelligence, gave very reliable accounts of what happened. I questioned and examined all the men myself, each man separately from the others, avoiding as far as possible any leading questions. The results of this examination are embodied in Tables 1 and 2, the cases being so similar that it would be tedious to describe each in detail.

In these tables each man is given a number and in the rest of the paper the cases are referred to by their numbers. The + sign means *symptom present;* ++, *symptom very marked;* —, *symptom absent.* In the column marked "Bowels," N means *regular or nothing unusual noted;* C, *constipation;* D, *diarrhea;* C→D, *constipation while in the boat, followed by diarrhea on return.* The last column shows the number of red cells per cubic millimeter and is entered as an index of the amount of anemia present. The blood changes, being the most interesting and the least studied characteristic of this toxemia, are treated in greater detail later.

Cases 1 to 15, in order of admission, came from D.4; the others from D.3, in order of admission. All the cases except the last three were admitted after the second trip of each boat; the last three came after the third trip of D.3.

TABLE 1

SUMMARY OF SYMPTOMS IN CASES FROM SUBMARINE D.4.

Number of Case	Date of Admission (1916)	Age	Temperature on Admission	Pulse Rate on Admission	Day of Onset of Symptoms: First Trip	Day of Onset of Symptoms: Second Trip	Vomiting	Pain in Abdomen	Bowels: N—As Usual, D—Diarrhea, C—Constipation	Dyspnea	Respiration Rate on Admission	Color of Urine as Described by Patient	Albuminuria, if Present Any Time After Admission	Edema of Face	Headache	Tingling of Hands and Feet	Jaundice	Millions of Red Cells per C. Mm.	Remarks
1	6/15	28	98.0	84	3	2	++	+	N	++	?	Very dark	+	—	++	++	+	2.56	Shooting pains in calves: insomnia after admission
2	6/15	36	98.6	80	5	....	+	—	C	+		Dark brown	+	+	+	+	+	1.78	Lowest blood count, but symptoms very slight on the trips: only vomited once in the boat
3	6/15	23	99.0	88	5	2	+	+	C	++	?	Dark red	+	—	+	+	+	2.25	On July 5th, had an attack of dyspnoea and vomiting in hospital; had been well the day before and was well next day
4	6/20	23	97.6	68	5	1	+	—	N	+	18	Port wine	—	—	—	+	+	2.23	Had no complaint except a little lassitude after return: jaundice was very marked and bile preseot in urine
5	6/20	27	98.4	?	4	1	+	+	N	+	?	Golden syrup	+	—	+	++	+	3.74	Frequency and scalding on micturition
6	6/20	34	99.0	76	NS	1	+	—	N	+	24	Dark red	—	—	—	+	+	2.10	Running of the eyes, and dryness of throat; felt quite well during first trip
7	6/20	29	98.4	70	NS	7	—	—	D	—	20	Brown	+	+	+	+	+	3.49	No symptoms at all until last day of second trip
8	6/20	28	98.4	68	NS	2	+	—	N	+	20	Dark red	—	—	—	+	+	3.33	No symptoms on first trip
9	6/20	22	98.4	56	3	1	++	++	C→D	+	22	Red	+	+	—	++	+	2.90	Very acute burning pain in upper abdomen during the trip
10	6/21	36	98.4	80	NS	NS	—	—	N	—	?	Strong tea	—	—	—	+	+	3.65	No symptoms except headache and lassitude: herpetic eruption developed on backs of his hands; easily cured
11	6/21	23	98.4	72	4	1	+	++	C→D	++	18	Claret	+	—	—	+	+	4.28	Only vomited once: shooting pains in the legs after return
12	6/21	24	99.0	100	6	1	++	++	C	—	?	Port wine	+	—	+	—	+	4.55	Pain in abdomen very acute during the trips
13	6/21	27	98.4	80		1	++	—	C→D	++	?	Blood red	+	+	—	+	+	3.14	Only in boat during second trip
14	6/24	22	98.4	66	3	1	++	++	C	++	20	Blood red	+	+	++	+	+	3.83	Continual salivation during trip: troublesome insomnia on return
15	6/24	22	97.8	72	4	2	+	—	N	+	20	Brown	+	+	+	+	+	3.73	Legs gave out in a race on leave after trip

A study of this table shows that there was little difference in the degree of toxemia suffered in the two boats. D.3 produced the worst cases when admitted, but on the whole the D.3 cases arrived earlier than those from D.4. Urinary symptoms, swelling of the face, and albuminuria appear to have been more marked in the men from D.3, and the three patients who took longest to get a blood approaching the normal came from her. This difference may well have been due to the fact that the second trip of D.3 was just twice

the duration of that of D.4. D.3's last trip, only an eighteen hour dive, apparently produced the most rapid onset of symptoms. As stated above, twenty out of twenty-six in the crew were affected to the point of vomiting, and it is fair to conclude that this trip, if continued, would have produced still more severe, if not fatal, cases. The history of onset points to D.3, at least in the first trip, as having the more poisonous atmosphere, since symptoms started in D.3's crew on the first or second day, whereas in D.4 the onset of symptoms on the first trip was delayed to the fourth or fifth day, and some men escaped without symptoms at all. Both second trips were worse than the first, symptoms starting from the first dive.

TABLE 2

SUMMARY OF SYMPTOMS IN CASES FROM SUBMARINE D.3

Number of Case	Date of Admission (1916)	Age	Temperature on Admission	Pulse Rate on Admission	Day of Onset of Symptoms: First Trip	Day of Onset of Symptoms: Second Trip	Vomiting	Pain in Abdomen	Bowels: N—As Usual, D—Diarrhea, C—Constipation	Dyspnea	Respiration Rate on Admission	Color of Urine as Described by Patient	Albuminuria, if Present Any Time After Admission	Edema of Face	Headache	Tingling of Hands and Feet	Jaundice	Millions of Red Cells per C. Mm.	Remarks
16	6/29	25	98.0	104	5	3	+	–	C→D	+	20	Mahogany	–	+	–	+	+	2.91	Scalding and frequency of micturition: had an attack of vomiting three days after admission
17	6/29	29	98.6	112	2	1	+	+	C	+	22	Tea color	++	–	+	+	+	2.72	Most marked and persistent albuminuria of any case
18	6/29	34	98.8	108	2	1	+	+	C	++	24	Port wine	+	–	+	++	+	1.98	Chief complaint, great thirst and burning of throat: blood showed more degenerative changes than any other
19	7/1	24	99.4	84	..	1	++	–	C	++	24	Very dark	+	–	+	–	+	2.60	Only did second trip, dryness of throat marked symptom
20	7/1	30	98.4	80	1	1	++	++	C	–	?	Port wine	+	++	++	+	+	3.51	Insomnia and fine tremor on admission scalding and frequency of micturition
21	7/1	23	98.8	80	2	2	+	+	C→D	+	20	Dark brown	+	–	+	+	+	3.24	All symptoms mild
22	7/1	23	99.0	88	NS	4	–	–	N	+	20	Brown	+	+	++	+	+	2.86	Insomnia on return: burning and dry throat
23	7/1	24	97.6	84	4	1	+	++	C	+	20	Red brown		+	++	+	+	2.79	Pain in joints, and neuralgia of testes on return
24	7/1	26	98.6	88	5	1	++	–	N→D	+	18	Reddish	+	++	–	+	+	4.03	Swelling of face noticeable, and pain down right arm after admission
25	7/1	22	99.2	92	2	1	++	++	C	+	24	Port wine	+	–	++	+	+	3.13	Dryness of the mouth, and shooting pains in the legs on return
26	7/7	35	98.0	72	2	2	+	–	C→D	–	?	Never noticed	+	–	–	++	+	3.94	Melena on return (?): cramps and spasms in left arm, pains in thighs and legs insomnia troublesome
27	7/7	38	99.2	84	3	2	+	–	N	+	?	Reddish	–	–	+	–	+	2.68	Had a shivering fit (no definite rigor) on admission to hospital after expiration of leave
28	7/28	24	99.2	84	Third trip only		+	–	N	–	?	Port wine	–	–	–	–	+	3.59	Only did third trip
29	7/28	30	98.6	90	3	3	+	–	N	+	?	Mahogany	+	+	+	+	+	4.13	Did all three trips: slight symptoms on first two, symptoms worst during the third trip
30	7/28	35	98.4	104	NS	NS	+	+	C	–	?	Strong tea	+	–	+	+	+	4.11	Only vomited after breaking surface on third trip

SYMPTOMS

Temperature and Pulse Rate.—The temperature of the patients was nearly always normal on admission. The pulse rate showed a tendency to be raised, especially in those cases seen earliest (e.g., Nos. 16, 17, 18). Notes on the hospital case sheets showed that most cases had a pulse rate of over 100 when first seen after return. One or two men had soft systolic *bruits* on admission. The pulse and heart conditions, however, were obviously only secondary to the anemia, and both settled down in a very short time to within absolutely normal limits.

Dyspnea.—Dyspnea, especially on exertion, was a very general symptom, only seven ratings saying that they did not notice it. In a few men it was the chief complaint, and this symptom was still evident in the majority of cases on admission. The dyspnea was evidently entirely due to the anemia, as no case showed any physical signs or symptoms of damage to the lung—a rather strange fact as the gas must have entered through the respiratory epithelium. In seventeen men, whose respiration rate was taken shortly after admission, while lying quietly in bed, the rate varied between 18 and 24 per min-

ute, showing a very slight rise above the normal.

Vomiting.—Vomiting was a constant feature; with most men it was continuous throughout the trip, but a few were only sick once or twice, and three men escaped this symptom altogether. The vomiting was accompanied in some cases by burning and griping pains in the upper abdomen, and by dryness and burning sensations in the throat. Fourteen of the cases admitted complained of pain in the abdomen, and in one or two ratings it was very acute indeed.

Constipation.—There is little to note about the bowels during the actual trips. Constipation was most generally complained of, but as likely as not it was due to the fact that the majority of the crew had no fancy for food and could keep nothing down. Eight patients, though constipated during the trip, had two or three days of mild diarrhea on return. Case 26 volunteered the statement that he passed a motion containing blood the day after he got back to Harwich.

Urinary Findings.—All ratings, with the exception of one man who did not notice it, were surprised by the color of their urine. The color was variously described as brown to blood red. (It should be remarked that some men, when possible, only micturated at night on the submarine breaking surface, so had little opportunity of seeing their urine while at sea.) The color was, in most cases, probably due to blood or its pigments, but for reasons discussed later in this paper, may in some cases have been due to bile only. Some men who complained of no other symptoms, passed dark urine on the first trip. The history given by the men who remembered the point, was that the urine became dark the day after the onset of symptoms, and remained dark till their return, when it became the ordinary color in two or three days. This hemoglobinuria certainly passed off very rapidly, as a most careful examination at the time of admission to the hospital failed to reveal any blood or pigments in the urine, either by microscopic, spectroscopic, or chemical methods. All urines, except those of Cases 16, 17 and 18 which contained obvious bile, were within normal color limits on admission. Besides the above three exceptions, the urine in four other cases gave a trace of bile by the iodine test, but not by Gmelin's nitric acid test. Case 28, however, throws light on the nature of the color of the urine and the reason of the failure to find a cause for it after admission. Fleet Surgeon O'Malley, to whom I am indebted for much useful information, states on the hospital case sheet of this man: "He returned in Submarine D.3 on 23d of July, this being his first voyage and first dive in a submarine. About the 12th hour submerged, he had headache and nausea and vomited a few hours later. He states his urine then was the ordinary color, and it was found to be normal in color and free from albumen when examined at 3 P. M. on the 23d inst.; but late that evening he passed a dark port wine colored urine containing albumen and blood;—Dr. Haldane found that this urine contained Haemoglobin and Methaemoglobin. The patient developed a slight yellow tinting of the conjunctivae on 25th July and his urine is now quite clear and free from albumen." (Dated July 28, 1916.) In this case, therefore, we have absolute proof that the urine contained blood and was absolutely normal four days after return.

Albuminuria was present at one time or another in all cases except three. This albuminuria was measurable in amount only on two occasions, both in Case 17. There was no difference in the morning and evening specimens of urine. In some cases albuminuria was absent on admission, appeared, cleared up, and reappeared in a most peculiar way. Table 3 contains three examples illustrating what is meant, and also includes the one case with persistent albuminuria. The specific gravity was roughly always normal, as was the amount passed in twenty-four hours in all cases where it was measured. The albumin was present only in traces.

The urine of Case 17 contained generally a few epithelial cells and one or two epithelial casts were found on the occasion when the albumin was at its highest. An epithelial cast was once found in the urine of Case 12; otherwise, in spite of careful hunting, no casts were ever found, though epithelium and leucocytes were often present in small numbers. Sugar, acetone, or other abnormal constituents of the urine were never detected. Bile,

TABLE 3
ALBUMINURIA IN CASES OF POISONING BY ARSENIURETTED HYDROGEN

Case 12		Case 2		Case 17		Case 18	
Date (1916)	Albumin	Date (1916)	Albumin	Date (1916)	Albumin	Date (1916)	Albumin
15/6 to 21/6	Nil	21/6	Nil	2/7 to 18/7	FT to T	2/7 to 11/7	Traces
5/7	FT	7/7	FT	19/7	0.05%	12/7	Nil
6/7	VFT	7/7	VFT	21/7	T	14/7	Nil
7/7	Nil	8/7	Nil	22/7	0.1%	15/7	T
9/7	Nil	12/7	Nil	23/7	Under 0.05%	19/7	Nil
10/7	VFT	2/8	FT	24/7	T	21/7	VFT
12/7	Nil	3/8	VFT	30/7 to discharge	Faint trace persists	23/7 to discharge	Nil
13/7	FT	5/8	T				
2/8 to discharge	Nil	6/8	VFT				
		8/8 to discharge	Nil				

VFT = Very faint trace on boiling.
FT = Obvious cloud.
T = Heavy cloud, under 0.05 per cent.

as mentioned above, was present in the admission urines of seven cases.

Edema.—Edema of the face and eyelids was not obvious in any case on admission, but the men were very certain that it had existed, and their messmates and the captain of D.3 noticed it and told me about it without any prompting, so I think there is no doubt that it did exist. It will be noticed that all the patients who gave a history of swelling of the face had albuminuria as well. There was no history in any case of swelling of the feet and ankles. I think this edema was undoubtedly due to a toxic nephritis, helped a bit by the concurrent anemia. Scalding and frequency of micturition, an out-of-the-way complaint of Cases 5 and 16, was probably caused by irritation of the bladder and urethral mucous membranes by arsenic. Though one or two other patients said that they passed urine more frequently, none except the above two complained of any scalding.

Conjunctivitis.—The metal, arsenic, is well known to cause irritation to any mucous membrane, and as some of the men complained of irritation and redness of the eyes, it seems as if the conjunctiva did not escape in all cases. This conjunctival irritation was probably caused by the arsenic brought by the blood stream, rather than by the direct action of what must have been a remarkably small amount of actual arseniuretted hydrogen in the air of the boats.

Headache and Insomnia.—Headache was a fairly constant symptom, and was persistent for some time after admission in many cases; it was very acute during the trip in some men, though many escaped it altogether. Insomnia which persisted for a week or two was troublesome in one or two of the ratings. The headache and insomnia may well have been secondary to the nephritis.

Neuritis.—Neuritic symptoms were present in every case except four. Of these four it is interesting to note that two had only done one trip, one of whom —the case quoted at length—had only been exposed to the gas for a day. This suggests that a considerable amount of gas had to be absorbed to produce any signs of neuritis. These symptoms did not, in the majority of cases, manifest their presence till three or four days after return from the voyage, but took two or three weeks to pass off. The neuritic symptoms consisted of vague tingling, numbness, "pins and needles" sensation in the hands and feet. The legs were prone "to go to sleep" easily, and a few men got cramps in the arms and legs at times. Some ratings also had various vague or shooting pains in the limbs, back, and joints. Another interesting point is that about half the men complained of toothache or facial neuralgia, and asked to see the dentist; and in one or two cases the dental surgeon reported no evident carious teeth. No objective nervous signs were present;

the knee jerks and other reflexes were normal, perhaps a little brisker than usual in a few men. There was no anesthesia detected.

Patient 15 described a peculiar thing that happened to him on leave. Feeling perfectly well, he went in at some sports for a 200-yard race but his legs suddenly "gave out" and he had to go to bed for two days with pain and tenderness of his calf muscles; he was, however, quite well within a week. I am at a loss to explain this attack, but it seems to have been a definite peripheral neuritis brought on by over-exertion in a man whose nerves had not properly recovered from an arsenical toxemia.

As an example of how a man was able to take exceptional exercise without bad results, I quote Patient 6 who was a keen long distance swimmer. He had been swimming nearly every day of his leave, and the day before he returned had swum over three miles and felt none the worse for it, either in wind or limb, and this a man who had had dyspnea, neuritic symptoms, and a count of only 2,100,000 red cells on admission.

Jaundice.—Jaundice was an absolutely constant sign. It was evident as a slight tinting of the skin and conjunctivae in most cases on admission, and all cases gave a history of it. The color never seems to have been very deep, but was always present. How noticeable it was, is shown by the fact that the men in other boats and adjacent ships referred to D.3 on her return as the submarine with the "Chinese crew." Bile was present in the blood serum and urine in a few cases, and there was no lack of bile in the feces. The jaundice passed off in about a week.

Before leaving the general symptoms to discuss the blood, it is worth noting that the degree of anemia present as indexed by the red count bore no direct relation to the acuteness of other symptoms.

For example, Patient 2 with the lowest

TABLE 4

Blood Findings in Cases of Arseniuretted Hydrogen Poisoning

	Complete Blood Count on Admission										Blood Count One Week After Admission										Blood Count Two Weeks After Admission										
Reference No. of Case*	Date of Count (1916)	Millions of Red Cells per C. Mm.	Hundreds of White Cells per C. Mm.	Hemoglobin per Cent.	Color Index	Differential Leucocyte Count: Polymorphonuclear Cells	Small Mononuclear Cells	Large Mononuclear Cells	Eosinophile Leucocytes	Basophile Leucocytes	Date of Count (1916)	Millions of Red Cells per C. Mm.	Hundreds of White Cells per C. Mm.	Hemoglobin per Cent.	Color Index	Differential Leucocyte Count: Polymorphonuclear Cells	Small Mononuclear Cells	Large Mononuclear Cells	Eosinophile Leucocytes	Basophile Leucocytes	Date of Count (1916)	Millions of Red Cells per C. Mm.	Hundreds of White Cells per C. Mm.	Hemoglobin per Cent.	Color Index	Differential Leucocyte Count: Polymorphonuclear Cells	Small Mononuclear Cells	Large Mononuclear Cells	Eosinophile Leucocytes	Basophile Leucocytes	Reference No. of Case
1	16/6	2.56	70	55	1.1	52.7	39.0	6.0	1.7	0.6	23/6	2.52	42	52	1.0	41.0	53.0	5.0	0.4	0.3	30/6	3.68	56	65	0.88	23.7	71.3	4.0	1.0	0.0	1
2	16/6	1.78	60	50	1.3	63.0	31.7	4.6	0.7	0.0	23/6	2.30	36	48	1.1	51.3	45.7	2.0	1.0	0.0	30/6	3.58	54	65	0.90	54.3	41.7	3.0	1.0	0.0	2
3	16/6	2.55	86	50	1.0	64.7	30.3	4.7	0.3	0.0	23/6	3.00	56	58	1.0	34.0	55.0	7.7	3.0	0.3	30/6	3.88	82	68	0.87	29.0	65.3	2.7	3.0	0.0	3
4	20/6	2.23	56	50	1.2	49.7	48.0	1.7	0.6	0.0	28/6	3.54	34	62	0.88	35.0	56.4	7.0	1.3	0.3	4/7	4.07	44	70	0.87	52.0	40.7	5.3	1.3	0.7	4
5	20/6	3.74	58	65	0.87	65.3	27.0	5.0	2.0	0.7	28/6	4.36	48	68	0.77	66.3	30.9	2.3	0.7	0.0	4/7	4.59	72	72	0.78	69.7	24.3	4.0	2.0	0.0	5
6	21/6	2.10	42	55	1.3	41.0	47.7	5.3	5.0	1.0	29/6	3.64	52	60	1.1	33.7	55.7	6.7	2.7	1.2	6/7	3.94	52	70	0.90	57.7	35.0	4.0	3.3	0.0	6
7	21/6	3.49	68	55	0.80	60.3	30.7	6.0	2.3	0.7	30/6	4.00	56	70	0.88	53.2	39.7	3.7	2.7	0.7	7/7	4.18	76	68	0.81	61.0	32.0	3.7	3.3	0.0	7
8	21/6	3.33	44	60	0.90	60.4	31.3	6.3	1.0	1.0	28/6	3.06	76	58	0.85	35.7	59.7	2.7	1.7	0.2	5/7	3.36	72	68	1.00	58.0	37.0	2.7	2.3	0.0	8
9	21/6	2.90	60	53	0.90	47.0	47.7	3.7	1.3	0.3	29/6	3.00	62	60	0.10	54.3	34.7	9.7	1.3	0.0	6/7	4.53	44	70	0.77	55.0	36.0	6.3	2.7	0.0	9
10	21/6	3.65	42	55	0.76	13.0	51.7	4.7	0.3	0.3	28/6	4.06	74	62	0.77	31.3	63.7	5.0	0.0	0.0	5/7	4.50	66	75	0.84	55.7	36.0	6.0	2.3	0.0	10
11	21/6	4.28	68	70	0.81	36.0	59.3	4.3	0.4	0.0	29/6	4.80	102	75	0.78	61.3	33.3	2.8	1.3	1.3	5/7	4.97	70	75	0.78	50.0	40.7	6.0	2.7	0.6	11
12	21/6	4.55	88	72	0.80	66.3	30.0	3.0	0.7	0.0	29/6	4.04	110	65	0.81	64.0	31.3	3.3	0.7	0.7	5/7	4.16	88	70	0.83	78.7	16.0	3.7	1.6	0.0	12
13	21/6	3.14	60	60	1.00	38.0	59.3	1.7	1.0	0.0	30/6	3.89	128	68	0.87	74.0	19.7	6.0	0.3	0.0	7/7	4.70	92	72	0.77	52.0	45.3	2.0	0.7	0.0	13
14	26/6	2.75	58	60	1.10	45.0	46.7	5.0	3.0	0.3	2/7	3.87	50	65	0.83	33.3	58.0	5.3	2.0	1.4	11/7	4.14	80	68	0.83	57.3	36.0	5.7	1.0	0.0	14
15	26/6	3.73	38	68	0.90	37.7	57.0	4.7	0.6	0.0	3/7	4.18	84	75	0.82	62.6	29.4	6.0	2.0	0.0	10/7	4.45	44	72	0.80	51.7	41.7	4.0	2.6	0.0	15
16	29/6	2.91	56	60	1.00	60.0	33.3	6.0	0.7	0.0	6/7	2.96	60	65	1.08	63.0	29.3	5.7	1.7	0.3	13/7	3.58	52	70	0.97	40.3	49.0	5.0	4.0	1.7	16
17	29/6	2.72	52	65	1.20	53.0	34.7	9.0	2.7	0.7	6/7	3.96	56	68	0.85	57.4	38.0	2.3	2.3	0.0	13/7	3.86	36	68	0.87	42.0	46.7	8.7	2.6	0.0	17
18	29/6	1.98	66	48	1.20	75.7	21.0	2.3	0.7	0.3	6/7	2.76	52	62	1.11	33.7	61.7	4.0	0.3	0.3	13/7	2.91	56	65	1.10	25.3	65.3	7.0	2.4	0.0	18
19	2/7	2.60	76	58	1.10	56.0	34.7	4.3	4.7	0.3	9/7	3.12	60	62	1.00	17.0	47.7	1.3	3.3	0.7	16/7	4.07	42	70	0.85	51.0	40.7	6.7	1.3	0.3	19
20	1/7	3.51	46	50	0.71	69.0	25.0	3.2	2.0	0.7	9/7	3.84	30	62	0.81	44.0	43.3	8.0	3.7	1.0	16/7	3.91	52	72	0.92	71.0	21.7	5.0	2.3	0.0	20
21	1/7	3.24	38	55	0.86	52.7	42.3	1.3	3.7	0.0	9/7	3.58	56	60	0.83	43.3	43.3	5.7	6.7	1.0	15/7	4.16	54	68	0.81	40.0	49.0	6.3	3.3	1.4	21
22	1/7	2.86	70	52	0.89	36.0	53.3	4.7	6.0	0.0	9/7	3.41	56	62	0.91	37.7	51.0	4.3	6.3	0.7	15/7	4.44	46	68	0.77	64.0	34.3	3.0	1.7	0.0	22
23	2/7	2.79	54	48	0.89	64.0	30.7	3.7	1.6	0.0	9/7	3.36	40	58	0.85	32.0	60.3	4.0	3.7	0.0	24/7	4.02	64	65	0.81	55.0	35.0	7.0	2.7	0.3	23
24	2/7	4.03	70	65	0.81	66.7	23.7	2.6	7.0	0.0	9/7	3.54	42	60	0.86	50.3	35.3	4.3	9.3	0.8	16/7	4.02	48	70	0.87	71.5	17.0	5.5	5.3	1.4	24
25	2/7	3.13	64	60	0.97	57.7	38.3	2.3	1.7	0.0	10/7	3.90	60	70	0.90	35.7	54.7	4.0	5.0	0.6	16/7	3.76	64	72	0.95	57.7	33.3	4.7	2.3	2.0	25
26	8/7	3.94	46	62	0.82	40.7	52.7	3.0	3.0	0.6	15/7	4.35	50	68	0.77	46.7	44.7	6.0	2.6	0.0	22/7	4.37	70	75	0.83	72.0	22.7	3.3	2.0	0.0	26
27	8/7	2.68	50	58	1.10	42.0	47.3	10.0	0.0	0.7	15/7	2.85	46	60	1.0	58.0	26.7	14.0	1.0	0.3	22/7	3.09	36	68	1.10	54.7	37.0	6.0	1.3	1.0	27
28	30/7	3.59	42	65	0.90	47.3	16.0	3.7	3.0	0.0	9/8	3.51	62	78	1.10	57.0	34.7	5.7	2.6	0.0	17/8	4.70	56	72	0.77	62.0	27.0	5.5	5.5	0.0	28
29	30/7	1.13	54	65	0.79	47.3	37.3	6.4	9.0	0.0	9/8	4.19	86	75	0.89	61.4	29.3	3.0	6.3	0.0	17/8	4.34	48	75	0.87	46.7	30.7	7.6	14.0	1.0	29
30	30/7	4.11	46	62	0.75	12.7	51.3	4.0	1.3	0.7	9/8	3.94	82	72	1.10	42.3	50.7	3.7	3.3	0.0	17/8	4.34	48	75	0.87	56.0	33.0	8.0	2.0	1.0	30

*Cases 1 to 15 are from D.4; Cases 16 to 30, from D.3.

number of red cells protested he was as fit as any man in the boat till the last day of the trip, whereas Patient 14 with little diminution of his red corpuscles had most severe general symptoms, acute pains in the head and abdomen, and continuous vomiting.

THE BLOOD

The Red, White, and Differential Counts

I investigated the blood in this condition as carefully as possible, since I can find little about the finer blood changes in the literature of the subject. Nearly 200 complete counts and hemoglobin estimations were made, besides many other observations; the majority of the counts are enumerated in Tables 4 and 5.

Red Blood Cells.—The erythrocytes on admission were reduced below 5,000,000 per c.mm. in every case; two cases had a count of under 2,000,000; in twelve cases the count was between 2 and 3,000,000; in 10 cases it was between 3 and 4,000,000; and in the remaining 6 men the number of red cells per c.mm. was over 4,000,000. The lowest count on admission was 1,780,000, the highest 4,550,000; thus the variation was considerable. The number of red cells increased very rapidly for the first fortnight, when the rate of increase slowed down. One week after admission only five men had a count under 3,000,000, and after a fortnight only one was below this number, while ten showed counts between 3 and 4,000,000. Three weeks after admission eight counts still were below 4,000,000 though not much below it, and at the end of the month only one patient (Case 1) had failed to reach 4,000,000 red cells per c.mm.

By the time the blood had reached 4,000,000, the patients were all feeling quite well and were given fourteen days' leave, on the expiration of which they returned to the hospital for further counts and observation.

The red cells in this last count were all

TABLE 5

BLOOD FINDINGS IN CASES OF ARSENIURETTED HYDROGEN POISONING (*Continued*)

Blood Count Three Weeks After Admission

Reference No. of Case*	Date of Count (1916)	Millions of Red Cells per C. Mm.	Hundreds of White Cells per C. Mm.	Hemoglobin per Cent.	Color Index	Differential Leucocyte Count: Polymorphonuclear Cells	Small Mononuclear Cells	Large Mononuclear Cells	Eosinophile Leucocytes	Basophile Leucocytes
1	7/7	3.78	60	70	0.90	35.7	60.0	4.0	0.3	0.0
2	7/7	3.93	60	68	0.87	58.4	36.3	5.3	0.0	0.0
3	7/7	3.98	80	70	0.87	60.0	33.3	4.0	2.7	0.0
4	..	..	..		..	..	..		.	..
5										
6	12/7	4.08	78	72	0.90	54.3	40.3	4.0	1.4	0.0
7	14/7	4.03	70	70	0.83	51.8	36.3	6.3	4.3	1.3
8	11/7	4.04	78	70	0.88	59.3	32.3	5.7	2.7	0.0
9	13/7	4.46	74	75	0.83	78.0	14.7	6.0	1.3	0.0
10	11/7	5.07	78	78	0.76	44.7	46.0	4.7	4.6	0.0
11	12/7	4.64	62	75	0.82	55.3	37.3	3.3	3.7	0.4
12	12/7	4.16	56	70	0.83	52.7	35.3	6.3	5.7	0.0
13	14/7	4.48	102	75	0.83	49.7	43.3	5.0	1.0	1.0
14	16/7	3.83	62	72	0.94	63.7	21.7	6.7	2.7	0.2
15	16/7	4.71	84	72	0.77	67.3	24.7	7.0	1.0	0.0
16	20/7	3.78	64	72	0.94	48.7	42.7	7.6	1.0	0.0
17	20/7	3.84	58	68	0.87	57.0	35.7	6.0	1.3	0.0
18	20/7	3.85	50	70	0.92	62.4	31.3	4.3	1.0	1.0
19	24/7	4.16	62	70	0.83	62.0	29.3	5.0	3.7	0.0
20	24/7	4.05	50	70	0.87	66.0	26.7	3.3	1.7	2.3
21	22/7	4.13	52	70	0.85	51.7	39.0	6.7	2.0	0.6
22	22/7	4.85	72	72	0.75	63.7	27.0	7.3	2.0	0.0
23	31/7	3.58	68	70	0.98	60.0	38.0	1.7	0.3	0.0
24	24/7	4.55	56	72	0.80	50.0	33.3	7.3	6.7	2.7
25	24/7	4.00	56	72	0.90	61.4	29.3	5.3	3.0	1.0
26	30/7	4.32	92	72	0.83	71.3	24.3	3.4	0.0	0.0
27	30/7	4.27	62	70	0.83	67.4	26.0	8.3	0.7	0.3
28	...	...	...		...	.	...	...	...	..
29	...	...	...		...		...	...	...	..
30	...	...	...		...	.	...	...	.	..

Blood Count Four to Five Weeks After Admission, on Discharge to Leave

Reference No. of Case*	Date of Count (1916)	Millions of Red Cells per C. Mm.	Hundreds of White Cells per C. Mm.	Hemoglobin per Cent.	Color Index	Differential Leucocyte Count: Polymorphonuclear Cells	Small Mononuclear Cells	Large Mononuclear Cells	Eosinophile Leucocytes	Basophile Leucocytes
1	14/7	3.95	64	70	0.87	45.0	39.0	8.7	5.3	2.0
2	14/7	4.04	60	72	0.90	68.0	26.7	4.7	0.3	0.3
3	14/7	4.20	90	75	0.89	61.0	26.3	8.0	4.0	0.7
4	.	..								
5										
6	.	.								
7		..								
8		.								
9		..								
10		..								
11										
12										
13		..								
14										
15										
16	10/8	4.45	60	72	0.80	71.3	17.7	10.0	0.7	0.3
17	10/8	4.67	40	78	[illegible]	46.7	43.3	6.0	3.3	0.7
18	10/8	4.39	52	75	0.85	53.7	41.0	3.7	1.3	0.3
19	31/7	4.11	50	75	0.91	47.0	47.0	5.0	1.0	0.0
20	31/7	4.04	62	68	0.85	64.0	27.3	7.0	0.7	1.0
21	31/7	4.53	50	70	0.77	54.3	34.3	6.0	4.7	0.7
22	31/7	4.18	52	68	0.81	37.3	59.3	2.0	1.0	0.0
23	8/8	4.53	64	70	0.78	66.0	28.7	3.3	2.0	0.0
24	1/8	4.86	68	72	0.74	69.0	19.0	4.7	7.3	0.0
25	31/7	4.86	64	75	0.76	51.4	42.3	5.3	1.0	0.0
26					.	.	.		.	..
27	.		..		.	.	..			.
28	.				.	.	.			.
29	.		..		..	.				
30		.	.		.	..	.			

Last Blood Count After Return from Leave, Before Discharge to Duty

Reference No. of Case*	Date of Count (1916)	Millions of Red Cells per C. Mm.	Hundreds of White Cells per C. Mm.	Hemoglobin per Cent.	Color Index	Differential Leucocyte Count: Polymorphonuclear Cells	Small Mononuclear Cells	Large Mononuclear Cells	Eosinophile Leucocytes	Basophile Leucocytes
1	1/8	4.66	64	82	0.89	51.7	33.3	10.7	6.0	0.3
2	1/8	4.47	52	78	0.87	53.7	38.3	7.0	1.0	0.0
3	8/8	4.50	86	82	0.91	66.7	22.7	8.0	2.3	0.3
4	21/7	5.04	48	78	0.78	41.7	44.0	6.7	3.6	1.0
5	21/7	4.95	74	75	0.76	70.3	22.3	4.0	2.0	0.4
6	2/7	4.50	42	80	0.89	58.0	33.4	7.3	1.0	0.3
7	1/8	4.54	56	82	0.91	68.0	22.7	8.3	1.0	0.0
8	2/8	5.59	78	75	0.67	[illegible]	41.7	5.7	2.3	0.0
9	2/8	5.79	62	80	0.72	56.7	36.7	5.3	1.0	0.3
10	1/8	4.64	60	80	0.87	53.7	41.0	3.3	1.7	0.3
11	2/8	4.34	84	82	0.95	58.0	35.0	5.7	4.0	0.7
12	1/8	4.31	84	75	0.87	57.7	35.7	5.6	1.0	0.0
13	2/8	4.39	92	72	0.82	43.7	51.7	3.3	1.0	0.3
14	1/8	4.03	60	80	1.00	32.7	58.0	4.0	4.7	0.6
15	8/8	5.01	48	82	0.82	53.7	40.0	5.3	1.0	0.0
16	29/8	5.04	70	85	0.85	58.0	31.0	8.7	2.0	0.3
17	29/8	4.96	64	82	0.82	58.3	33.0	5.7	2.7	0.3
18	29/8	4.88	50	82	0.85	65.7	31.0	2.0	1.0	0.3
19	19/8	4.88	56	85	0.87	70.3	22.3	5.7	1.0	0.7
20	21/8	5.04	50	85	0.85	60.0	31.7	8.3	0.0	0.0
21	20/8	4.50	52	78	0.86	65.0	26.0	6.0	2.0	1.0
22	20/8	5.02	48	82	0.82	52.7	38.3	5.7	3.3	0.0
23	29/8	5.15	72	90	0.90	69.3	20.3	8.0	2.0	0.4
24	19/8	4.48	78	80	0.89	80.7	12.3	6.0	0.7	0.3
25	20/8	4.89	60	80	0.80	57.7	36.0	4.3	1.0	1.0
26	19/8	4.61	72	85	0.92	66.7	26.7	4.7	1.7	0.2
27	21/8	5.12	54	80	0.80	52.0	36.4	10.0	1.3	0.3
28	8/9	5.04	50	75	0.75	63.8	29.3	5.3	1.3	0.3
29	8/9	5.11	80	85	0.83	50.0	34.0	4.7	11.0	[illegible]
30	8/9	4.85	72	82	0.84	59.3	32.0	5.3	2.7	0.7

*Cases 1 to 15 are from D 4; Cases 16 to 30, from D 3

well over 4,000,000 and the majority well in the neighbourhood of, or over, 5,000,000.

White Blood Cells.—The white cell count showed little divergence from the normal (6,000 per c.mm.), but a glance at the admission counts and the last counts, show the latter to be generally higher than the former, and nearer the normal number. We may, therefore, say that the number of leucocytes in this disorder is unchanged or tends to a leucopenia.

The hemoglobin, as one would expect from the constant hemoglobinuria, was reduced in all cases, but not to the extent that the number of red cells on admission in the worst cases would indicate. It varied between 72 per cent. and 48 per cent. on admission; in only six cases was it 50 per cent. or less. The hemoglobin content improved more slowly than the number of red cells, as is usual in most anemias. At the time of the last estimation, roughly seven weeks after the last trip of the submarines, no blood contained less than 70 per cent. and the majority of bloods were up to 80 per cent. of the normal hemoglobin content.

The color index illustrates the relation of the hemoglobin to the red count. On admission it was generally high, twelve cases actually having an index over one. After a fortnight three cases were still over one. Before going on leave, no patient had an index over one, and only six had a color index above 0.9.

Differential Counts.—Three hundred leucocytes were counted in each case. There was nothing very characteristic about the differential counts; these varied greatly from week to week, both collectively and individually. A relative and an actual lymphocytosis (small mononuclears) was the general rule. This lymphocytosis was very marked in many cases. It seemed to reach its height about a week after admission, roughly a fortnight after the patient had left the submarine. For example, on admission only six men showed a small mononuclear count of over 50 per cent. (normal limits, 20 to 30 per cent.), whereas twelve reached 50 per cent. at the time of the second estimation. The greatest lymphocytosis was 71.3 per cent. (Case 1, 3d count). This is high enough to suggest leukemia in a case of unknown causation. The large mononuclear cells scarcely varied from the normal in any case, at any time.

The eosinophile leucocytes were increased above the normal in many cases at different times, suggesting that "eosinophile crises" are a feature of this toxemia. That the eosinophilia is not coincidental is shown by the numerous occasions on which it was above normal limits (4 per cent.), especially in the early counts; while in the last counts in only two cases (Nos. 1 and 29) did it exceed the normal. This shows that the increase of eosinophile cells did not occur when the blood had been restored to its original composition. In the two cases just mentioned, the blood of Case 1 was the slower in recovering. Case 29 had the highest eosinophilia throughout, with the blood otherwise little affected; therefore in his case the condition was probably an idiosyncrasy, or due to some undiscovered coincident cause.

All the chief points of the various blood counts are contained in Table 6. This table is made by averaging the weekly counts of six cases,—three (1, 2 and 6) from D.4, and three (16, 17 and 18), the earliest cases admitted from D.3. Figure 1 illustrates the same points graphically.

The following points previously discussed become evident at once in the dia-

TABLE 6

Average of Weekly Blood Findings of Six Cases of Arseniuretted Hydrogen Poisoning

Time of Count	Millions of Reds per C. Mm.	No. of White Cells per C. Mm.	Hemoglobin per Cent.	Color Index	Lymphocytes per Cent.
On admission	2.34	5770	55.5	1.19	34.6
One week after	3.02	5330	60.8	1.04	47.2
Two weeks after	3.59	5100	67.1	0.91	51.5
Three weeks after	3.88	6170	70.0	0.90	39.4
Four weeks after	4.30	5520	72.4	0.85	33.5
Six weeks after	4.75	5700	81.5	0.86	33.3

gram (Fig. 1):

1. The steady rise in the number of red cells toward normal, quick at first, slowing down later.

2. The hemoglobin reduction which is not at first as low, in proportion, as the number of red cells. This line also rises steadily toward normal, but not as fast as the red cell line which crosses it at the middle of the second week.

3. The color index, at first above one, crossing to below the normal line at the same time exactly as the hemoglobin crosses the red cell line. (The index is, of course, above or below one, according as the number of red cells is less or more reduced in proportion to the hemoglobin content.) The index line drops more and more slowly till just at the time of the last count it is beginning to rise, showing that the hemoglobin is just beginning to catch up with the number of red cells.

4. The number of white cells is seen to be just a little below the normal line. This leukopenia is most marked at the second week.

5. The high percentage of lymphocytes is at its maximum at the second week, after which it slowly approaches the normal. It will be noted that the maximum relative lymphocytosis corresponds in time to the minimum number of white cells per cubic millimeter.

Theoretically, when the blood is perfectly recovered, all these lines should meet on the normal lines and coincide with them. They can all be seen to be approaching the normal lines at the time of the last count.

The Stained Films

In the majority of cases, the appearance of the red cells in stained films revealed very little change. At the time of admission there was some variation in size, many of the cells being smaller than, and a few larger than normal. A few of the earlier films exhibited a slight degree of general polychromasia. Nucleated red cells were present, but very scarce, in ten cases. Two notable exceptions to the above general description must be described, *viz.,* cases 17 and 18.

These two cases showed marked degenerative changes in the erythrocytes, microcytes and macrocytes being very numerous. Typical poikilocytosis was also present, a condition not noted in any of the other bloods. General basophilic staining and punctate basophilic stippling of the red cells was excessive. Erythroblasts were numerous, whereas, in all other cases, they were difficult to find and were always normoblasts if found. In these two cases both megaloblasts and normoblasts were easy to find, some of the cells exhibiting bi- or tripartite nuclei, while in many instances the non-nuclear part of the cell exhibited general basophilia and stippling. In Case 17 the number of nucleated reds per 300

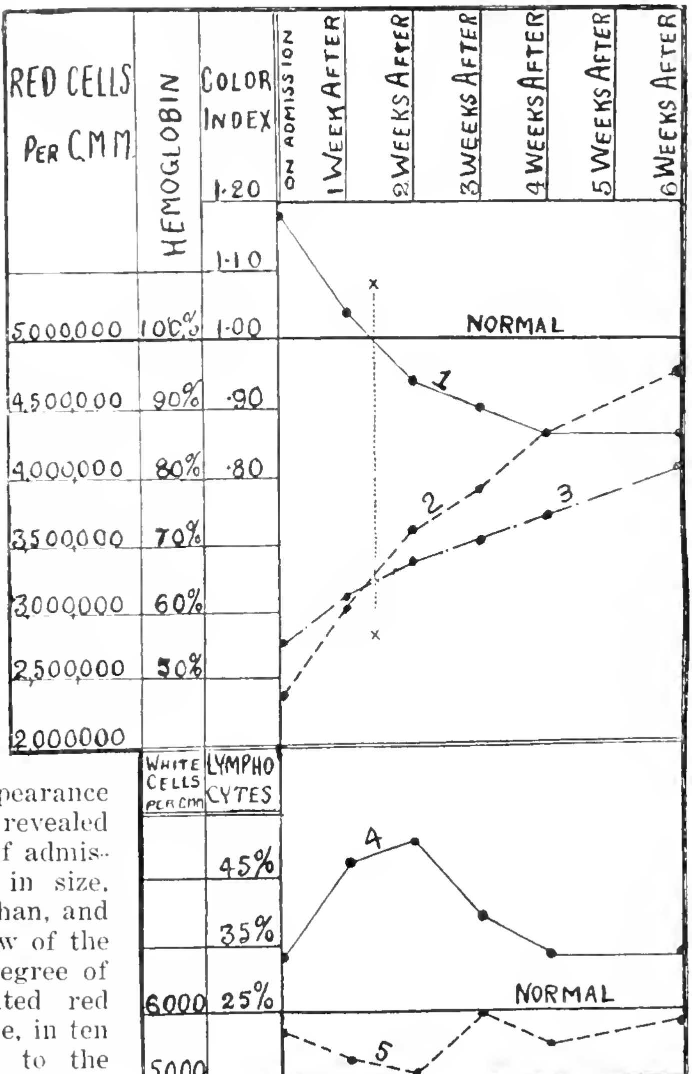

FIG. 1.—Diagram of average weekly changes in the blood of six cases of arseniuretted hydrogen poisoning. The indications of the various lines are as follows:

1—Color index.
2—Red cells per c.mm.
3—Hemoglobin percentage.
4—Percentage of lymphocytes.
5—White cells per c.mm.

The broken vertical line emphasizes the color index becoming "one" at the same time that the red cell line crosses the hemoglobin line.

white cells was two megaloblasts and three normoblasts. Case 18 showed the worst blood seen. In a differential count of three hundred white cells, fourteen megaloblasts and eight normoblasts were counted.

Let us review for a moment the blood findings in this case as shown in Table 4. What is found? A man with less than 2,000,000 red cells, a high color index, advanced degenerative changes in the reds, numerous erythroblasts, megaloblasts more plentiful than normoblasts, and bile-stained serum. What is this blood? Obviously a case of pernicious anemia. Could it be any other condition? Extremely unlikely, yet it is. Does it throw any light on the etiology of pernicious anemia? To my mind, it is extremely suggestive of a toxemic cause for the latter. In my opinion the most extraordinary observation made in this condition was the rate at which the advanced degenerative blood picture disappeared. Three days later, that is, five days after being removed from the influence of the poisonous gas, these two bloods were reexamined. Polychromasia and variation in the size of the red cells were no more marked than in many of the other bloods. Poikilocytes and stippled cells were remarkable for their absence. Two nucleated red cells (normoblasts), were discovered in the film from Case 18 and not one in Case 17, while 300 white cells were counted. The above facts were so startling that I sent the slides to Dr. Bassett-Smith who confirmed my findings. These two patients (with Case 16), were seen within forty-eight hours of leaving their boat, whereas no other men arrived at Chatham till five days had elapsed. This rapid clearing up of the changes in the red cells leads one to think that many other cases would have presented the same changes if seen earlier. However, against this view, is the fact that Case 16 did not present these changes though admitted at the same time as Cases 17 and 18. In Case 16 nucleated reds were very scarce, and there was slight polychromasia and variations in the size of the red cells, but nothing approaching the changes in 17 and 18.

The Fragility of the Red Cells

Some other observations were made on the blood of these cases. It was thought that the action of the gas might have damaged the walls of the blood corpuscles causing them to be more "fragile," that is more permeable to the escape of their contents than normal blood corpuscles. The fragility of a red cell is indicated by the amount of salt that must be added to distilled water to prevent the escape of its hemoglobin. In normal blood only 0.3 to 0.4 per cent. of salt is necessary to prevent laking. Increase in fragility is an especial feature in acholuric jaundice which seems in some ways analogous to this toxemia. An increase of fragility was expected. Contrary to expectation, it was found that the cells of these submarine cases were, if anything, less fragile than usual at the time they were examined. Four cases, Nos. 4, 6, 17 and 18, were tested the day of admission and after their return from leave. My own blood, which has been tested many times with invariably the same results, was used as a control to each test. Table 7 shows the results of the tests.

The point at which some of the cells begin to lose their hemoglobin is indicated by the strongest percentage of salt solution to show any coloration of the supernatant fluid when the cells settle to the bottom of the tube containing the mixture. The point of complete loss of hemoglobin by all the cells is shown by the strongest salt solution in which no cells settle to the bottom of the tube (complete hemolysis). A glance at Table 7 shows that there was little change in the fragility. In fact, the tendency was for fragility to be less marked in the patients' bloods than in the control, and, what is more striking, the bloods were more fragile if anything when the patients had recovered than on their admission (except Case 6). If this is a fact, the strength of the cells to resist osmotic pressure is increased in cases recovering from arseniuretted hydrogen poisoning. I would venture the following possible explanations: Either the gas destroyed all the weaker cells so that those left at the time of admission were stronger than normal, or, more likely, in these cases the average size of the red cells tended to be a little smaller than normal (see above). Mathematically, provided other factors were equal, it would take a greater osmotic pressure to stretch the wall of a

small sphere or corpuscle to the same extent as a large one. Thus a blood with small corpuscles would be less fragile than one with large corpuscles, presuming all other factors to be equal. [N.B. It is a well known hydrostatic formula that $2T = PR$, where $T =$ the tension on the wall of a sphere: $P =$ Pressure in the sphere (in this case osmotic pressure): $R =$ Radius of the sphere. If P remains constant, T varies directly as R.]

The serum of these four cases was deeply bile stained and gave the usual bile reactions. No free hemoglobin or methemoglobin could be detected by the spectroscope in the serum after removal of the blood corpuscles by centrifuging.

The Arneth Count

This method is not yet in common use, but I am sure it is one which deserves more attention. Briefly, the way in which the count is performed is this. One hundred polymorphonuclear leucocytes are counted and are divided into five classes, according as the nucleus of the cell has 1, 2, 3, 4, or 5 divisions. It has been found that the proportion of cells in each class remains fairly constant in health, but in any toxic condition the cells with fewer divisions in their nuclei increase, and classes 1 and 2 exceed classes 3, 4 and 5. So considerable is this "drift to the left," that to my mind it disposes of the great disadvantage of the count, i.e., the personal element. There is no doubt personal equation comes in very strongly in these counts since the divisions between the five classes are not always sharp, but if each investigator practices by counting normal bloods he will get his own idea of a normal count as compared with other investigators. It should be insisted too, that cells must only be counted in thin parts of the film where the red blood corpuscles are spread out to a single layer and the leucocytes well flattened. If these two points were consistently regarded results would become more comparative.

TABLE 7
RED CELL FRAGILITY TESTS*

	On Date of Admission			On Return from Leave		
No. of Case	Complete Hemolysis	Partial Hemolysis	No Hemolysis	Complete	Partial	No
Control	0.4	0.425	0.45	0.4	0.425	0.45
4	0.375	0.4, 0.425	0.45	0.4	0.425	0.45
6	0.425	0.45	0.475	0.4	0.425, 0.45	0.475
17	0.325	0.35, 0.375, 0.4	0.425	0.375	0.4	0.45
18	0.35	0.375, 0.4	0.425	0.375	0.4	0.45

*The figures given are percentages of sodium chloride solution.

Ten bloods from naval ratings in apparently perfect health gave the following average counts:

Case	Cell Class					Per Cent. Classes 1 and 2	Per Cent. Classes 3, 4 and 5
	1	2	3	4	5		
Average count of ten normal bloods	16.6	25.8	42.9	12.7	2.0	42.4	57.6
A. Blood of healthy man, with largest number of cells in Classes 1 and 2	20	31	37	10	2	51	49
B. Blood of healthy man, with smallest number of cells in Classes 1 and 2	10	21	44	21	4	31	69

My average count gives classes 1 and 2 a little higher than Arneth's normal which is 40 per cent. Counts A and B give the widest variations among the ten healthy men examined. A count like A does suggest some mild undiscovered toxemia, such as a bad tooth.

Allowing a big margin for error, one may safely say that if the cells in classes 1 and 2 exceed in number those in 3, 4, and 5, the case in question is suffering from a toxic condition of some sort. Table 8 contains the Arneth counts on eleven of these submarine cases. Each case had three counts done from blood films taken on admission, about three weeks later, and on returning from leave. In addition an average count was made from the eleven counts in each period.

An inspection of the average count shows that on admission the cells in

classes 1 and 2 reached over 80 per cent., double the normal number to be expected in health. After three weeks, the average count had dropped to 69.2 per cent.; on return from leave it was 56.9 per cent. This last fact indicates that the blood was still reacting to some toxic agent, though there were no symptoms in any case and scarcely any indications in the ordinary blood examinations to suggest that the men, on their return from leave, were in any way toxemic.

TABLE 8
ARNETH COUNTS ON ELEVEN CASES OF ARSENIURETTED HYDROGEN POISONING

Case	On Admission							Three Weeks Later							On Returning from Leave						
	Cell Class					Per Cent. Classes 1 and 2	Per Cent. Classes 3, 4 and 5	Cell Class					Per Cent. Classes 1 and 2	Per Cent. Classes 3, 4 and 5	Cell Class					Per Cent. Classes 1 and 2	Per Cent. Classes 3, 4 and 5
	1	2	3	4	5			1	2	3	4	5			1	2	3	4	5		
1	36	40	21	3	0	76	24	25	46	26	2	1	71	29	30	34	32	4	0	64	36
4	21	37	32	10	0	58	42	20	31	43	6	0	51	49	25	33	34	7	1	58	42
5	48	35	15	2	0	83	17	30	40	27	3	0	70	30	43	32	20	5	0	75	25
6	50	40	10	0	0	90	10	24	37	28	9	2	61	39	15	33	40	10	2	48	52
16	48	38	13	1	0	86	14	41	35	19	5	0	76	24	24	33	34	9	0	57	43
17	42	42	14	2	0	84	16	35	40	22	3	0	75	25	25	44	27	4	0	69	31
18	64	28	7	1	0	92	8	38	48	10	4	0	86	14	18	31	41	9	1	49	51
21	59	27	11	3	0	86	14	45	38	15	2	0	83	17	44	39	15	2	0	83	17
23	36	44	18	2	0	80	20	18	35	34	13	0	53	47	11	29	52	8	0	40	60
25	35	44	19	2	0	79	21	26	42	27	5	0	68	32	16	25	48	10	1	41	59
26	45	36	19	0	0	81	19	26	41	26	7	0	67	33	15	27	44	14	0	42	58
Average Count	44	37.3	16.3	2.4	0	81.3	18.7	29.8	39.4	25.1	5.4	0.3	69.2	30.8	24.2	32.7	35.2	7.4	0.5	56.9	43.1

Turning to the individual counts, it will be seen that most cases showed progressive improvement, Cases 6, 23, 25 and 26 being practically "normal" at the time the blood for their last count was taken. Case 4 is peculiar; his Arneth count showed little reaction on admission but remained the same on the two subsequent occasions. Cases 5 and 21 showed marked reactions in the first counts, reactions which did not improve to any appreciable extent in the other two counts. If this method of examination is reliable it may be another indication of the well-known fact that the elimination of arsenic is much slower in some people than in others. For example, Case 21, seven weeks after exposure to arseniuretted hydrogen, still retained sufficient arsenic to give a marked toxic Arneth count in his blood, whereas in the same period Case 23 had eliminated all of his arsenic and had a normal count.

THE BLOOD PRESSURE

In some conditions, such as blackwater fever, where the destruction of blood cells and hemoglobinuria are marked symptoms, the blood pressure is considerably lowered. Unfortunately, I did not know this fact till Fleet Surgeon Bassett-Smith told me of it, so the cases had been in the hospital some time before I tried to find out if the blood pressure was lowered in this toxemia. Table 9 gives a list of systolic blood pressures in millimeters of mercury, with the dates on which the observations were taken. The first column contains pressures taken before the patients went on leave, and the second column pressures taken after return from leave. This table shows nothing of much interest. Case 6 had an abnormally high pressure which was checked on two occasions; no cause could be found for it. There is no very marked difference in the pressure before and after leave. The four cases with systolic pressures below 120 mm. before going on leave, included the two cases in which the bloods showed the most marked changes (Cases 17 and 18), and the pressure in these two cases had gone up considerably by the time they were readmitted to the hospital. This is the only indication that the blood pressure may have been considerably reduced in the acute stages of the toxemia. It should be noted that the blood pressure in

nearly all these men is higher than is generally to be expected in men of their age. In this connection my experience seems to be the same as that of Surgeon Lovel Moss, who suggests that the average sailor has a higher blood pressure for his age than is usual (*Journal of The Royal Naval Medical Service*, October, 1916), or perhaps the higher average pressure is due to a residual effect of the poison on the kidneys or vessels.

ARSENIC EXAMINATIONS

The following tests for arsenic were done:—

1. *Urine.*—Forty to sixty ounces of the urine passed during two days after admission were concentrated and examined for arsenic in eighteen cases. Only three cases gave positive results:

Case 16	A trace	Urine examined within 3 days of leaving submarine.
Cases 17 and 18	Very strong mirrors of arsenic.	

These three cases were the only ones whose urine was tested less than a week after leaving the submarine.

2. *Blood.*—Twenty-five cubic centimeters of blood were drawn off the day of admission from Cases 17 and 18. No arsenic could be recovered from this amount of blood and serum.

3. *Finger and Toe Nails.*—Finger and toe nails examined gave no individual positive results, but the nail parings of ten cases mixed together and tested by Reinsch's test proved the presence of arsenic in the finger and toe nails.

4. *Hair.*—My own earlier examinations by Reinsch's test were negative but I was using too coarse a technique and too small quantities of hair. Early samples from twelve cases of both hair and nail parings were sent to Greenwich where Dr. Bassett-Smith and Professor Brain obtained positive results in seven out of twelve cases; they also confirmed the presence of arsenic in the urine of Case 18. Using more delicate apparatus and technique (recommended in the *Report of The Royal Commission on Arsenic Poisoning*) and 2 gm. of hair in each case, I examined seven men's hair a month to six weeks after they had left the submarine. The results are tabulated as follows: those which gave the strongest positive results being placed first:

TABLE 9

SYSTOLIC BLOOD PRESSURE IN CASES OF ARSENIURETTED HYDROGEN POISONING

No. of Case	Date of Admission (1916)	* Date of Observation (1916)	Blood Pressure 1: Before Going on Leave	Date of Observation (1916)	Blood Pressure 2: After Return from Leave
1	15/6			1/8	135
2	15/6			1/8	143
6	20/6			1/8	170
7	20/6			1/8	124
8	20/6			2/8	130
9	20/6			2/8	132
10	21/6			1/8	140
11	21/6			2/8	134
12	21/6			1/8	145
13	21/6			2/8	134
14	24/6			1/8	138
15	24/6			3/8	134
16	29/6	21/7	142	29/8	128
17	29/6	25/7	118	29/8	138
18	29/6	25/7	108	29/8	125
19	1/7	25/7	140	21/8	132
20	1/7	25/7	136	21/8	140
21	1/7	25/7	124	21/8	128
22	1/7	25/7	114	21/8	125
23	1/7	25/7	110	30/8	132
24	1/7	25/7	129	21/8	130
25	1/7	24/7	135	21/8	135
26	7/7	27/7	135	21/8	132
27	7/7	25/7	126	21/8	152
28	28/7	3/8	130	11/9	120
29	28/7	3/8	130	11/9	125
30	28/7	3/8	125	11/9	130

Case Reference No.	Result of Marshing
17	Dense brown-black deposit of arsenic
16	Very good mirror
18	Very good mirror
23	Good mirror
28	Large trace
29	Small trace
30	Small trace

Though I have far too little experience to do quantitative arsenic estimations, it is interesting to note that the largest amount of arsenic was obtained from the hair of the man with the most persistent albuminuria; that the smallest amounts were from two cases who had been in three trips each but had had very mild symptoms only. It certainly looks as if these latter did not absorb the arsenic inhaled to the same extent as the former, or else excreted it at once by the urine and feces. Though a skilled chemist would probably have obtained more positive results, I think arsenic has been recovered often enough to prove it definitely to be the cause of the condition. Numerous blank experiments were performed with the apparatus and reagents to make certain they were arsenic free, so the positive results that were obtained can be relied on.

THE ACTION OF ARSENIURETTED HYDROGEN ON BLOOD

To perform these experiments, arseniuretted hydrogen was generated by adding at short intervals small quantities of a 1 per cent. solution of arsenic trioxide in dilute hydrochloric acid to a hydrogen apparatus. The delivery tube of this apparatus dipped into a small flask containing the fluid under observation, so that the mixture of hydrogen and arseniuretted hydrogen evolved could be bubbled through it. Hydrogen has no action on the blood, so any results obtained were due to arseniuretted hydrogen. For precaution's sake these experiments were performed in the open air. If arseniuretted hydrogen produced in this way is passed through blood to which enough sodium citrate solution has been added to prevent clotting, the blood gradually darkens to a chocolate color. No further darkening can be detected after the gas has been passing from four to eight minutes. Exactly the same thing happens if, instead of using the whole blood, blood cells which have been washed four times in physiological saline solution are used.

Samples of blood and washed blood cells were treated with the gas for fifteen and forty-five minutes, and were then examined with the microscope and spectroscope. The observed changes were similar in all respects whether the whole blood or only washed blood cells were used, or whether the time of exposure to the gas was short or long. The samples all darkened to a dark chocolate color. On centrifuging, a perfectly colorless supernatant fluid was obtained, no trace of hemolysis having occurred. The deposits of "red" cells at the bottom of the centrifuge tubes were almost black. Stained films made from the centrifuged cells appeared absolutely normal; no changes could be detected in the red or white corpuscles. Wet unstained preparations also revealed no discernible change. There were no broken or swollen cells, nor were there any cell "ghosts" (i.e., red cells which have lost their colored contents). No agglutination or clumping of the red cells could be seen in these wet preparations. On standing overnight the supernatant fluid was tinged brown, but only a little more than controls of untreated blood were tinged red. Some of the dark colored cells were laked to a chocolate colored solution by the addition of distilled water, and examined with a spectroscope. (N.B.—The only spectroscope at my disposal was a small direct vision instrument, so very detailed or accurate spectrum analysis was not to be expected.) The spectrum of oxyhemoglobin was very evident, the two characteristic absorption bands between the *D* and *E* lines seemed to be as strong as in normal blood. In some samples, suitably diluted, the absorption band of methemoglobin in the red part of the spectrum between the *C* and *D* lines could be faintly made out, but only with great difficulty. The oxyhemoglobin gave the usual reactions; a drop of ammonium sulphide solution gave the spectrum of reduced hemoglobin, and a drop of potassium ferricyanide solution at once produced a *strong* methemoglobin spectrum, with *no further darkening* of the solution.

Another experiment was performed on blood which had been laked by distilled water before the arseniuretted hydrogen

was passed through it. On passing the gas through this hemolysed blood, instead of taking four to eight minutes, the solution almost immediately became a deep chocolate brown. A spectroscopic examination of this fluid revealed a strong methemoglobin spectrum with no sign of the oxyhemoglobin spectrum. This spectrum gave the ordinary changes to be expected on treating the fluid with ammonium sulphide or acids.

To see if arseniuretted hydrogen had any tendency at all to cause hemolysis, this experiment was devised. Blood was well diluted with 0.5 per cent. sodium chloride solution instead of 0.9 per cent., with the idea of increasing the permeability of the red cells by using a hypotonic salt solution. Still no trace of hemolysis occurred after passing the gas for an hour, but on standing for four or five hours some of the corpuscles had discharged their contents, as revealed by the color of the salt solution and by the microscope.

These experiments show that arseniuretted hydrogen has little obvious effect on blood *in vitro* except to change its color. On laked cells, however, that is on a solution of oxyhemoglobin, it has the power of quickly converting the whole of it into methemoglobin; whereas if the oxyhemoglobin is in the red cells instead of free in solution, the arseniuretted hydrogen has much more difficulty in effecting this change and seems only able to convert a small part of the coloring matter in the cells into methemoglobin. The marked change in the color of the blood would indicate that most of the coloring matter had become methemoglobin, but, as seen above, the spectroscope does not confirm this view.

I thought at first that arseniuretted hydrogen might form a compound with hemoglobin analogous to carboxyhemoglobin, but the spectrum obtained after passage of arseniuretted hydrogen through blood is, as far as I can make out, identical with oxyhemoglobin, and gives all the reactions of the latter. But the marked change in color, combined with the difficulty of obtaining the methemoglobin spectrum in whole blood, does suggest that arseniuretted hydrogen enters into a loose preliminary combination with the cells, which is indicated by a darkening of the color. The experiments also show that the gas has very little or no tendency to cause hemolysis, though the last experiment does suggest that it damages or increases the permeability of the cell membranes very slightly if helped by the action of a hypotonic solution of salt.

The absence of the fluid components of the blood makes no difference to the above phenomena, so complement or other constituents of the blood plasma are not necessary in these reactions.

Though caution is necessary in making deductions as to what happens *in vivo* from experiments *in vitro*, it seems as if arseniuretted hydrogen does not itself directly cause the liberation of blood pigments into the serum but damages or alters the contents of the red cells. Probably the liver, one of the functions of which is to remove useless blood cells, destroys these altered cells and liberates the pigment. Provided too many damaged cells are not thrown into the liver, the pigment is converted into bile. This bile, owing to congestion of the bile ducts or to some other reason, arrives in the general circulation by the hepatic veins, giving rise to the jaundice and to bile in the urine. From the men's descriptions of the color of their urine as being brown rather than reddish, in many cases, and from Fleet Surgeon O'Malley's account of cases not sent to the hospital, it would seem that in many cases bile only, and no blood pigments, appeared in the urine. If, however, a large excess of damaged cells were produced, probably so great a strain was thrown on the liver that it could not convert all the blood pigments into bile, and consequently hemoglobin and methemoglobin appeared in the urine in the more acute cases. (Incidentally some of the blood pigments and any whole blood that appeared in the urine might have been due to the accompanying toxic nephritis.)

The above hypothesis fits the facts and appears more reasonable than the theory that the blood cells were directly hemolysed in the blood vessels by the gas absorbed into the circulation. It also places the origin of the jaundice in the liver, where in all other cases it has been proved to arise, and does away with any necessity of considering this condition to be a hematogenous jaundice.

MEN NOT ADMITTED TO HOSPITAL

The preceding pages deal only with cases that were admitted to the Royal Naval Hospital, Chatham, and came personally under my own observation. I have obtained a few facts about the other members of the boats' crews from Fleet Surgeon O'Malley and from the commander of D.3.

There were fifty-six men in the crews of both boats; of these, thirty were considered bad enough to be sent to the hospital; fifteen were on the sick list of their parent ship with mild symptoms; two men were sent to Shotley Sick Quarters with an "erythematous rubelliform rash." These two, with Case 16, are the only three who had skin lesions, and these not especially typical of arsenical poisoning. The rashes were probably manifestations of a toxemia, analogous to the erythemas which sometimes follow the intravenous injection of salvarsan and other arsenical compounds. The remaining eleven men, though nearly all of them felt seedy and had symptoms during the trips, felt quite fit to carry on their duty on return. There was, however, one E.R.A. in D.3, who went through all three trips and maintained he felt no symptoms or effects whatever. Thus, we have, out of 56 men exposed to the gas, 30 men bad enough to be sent to the hospital; 15 men bad enough to be put on the sick list for a day or two; 10 with symptoms so mild that they could carry on duty; and 1 with no symptoms whatever. This list excludes the new hands in D.3's third voyage.

CONCLUSION

A feature of this outbreak of poisoning is the remarkable difference in the way individuals reacted to the gas. There is a complete graduation of symptoms, from a man who was apparently unaffected at all to a patient with such marked signs and symptoms as Case 18. This variation in effect was seen to be just as well marked in the blood changes as in the subjective signs. Now all the men in the same boat must have had equal chances of getting the same dose of the poison. The air in a submerged submarine must be well mixed, since the amount of carbon dioxide is so great that unless the air is kept circulating respiration becomes uncomfortable. (A note on one of the case sheets states there was 2.99 per cent. of carbon dioxide in D.4's atmosphere.) The result of this circulation would have been to distribute equally throughout the boat any arseniuretted hydrogen in the air. It was also found on inquiry that the fact of a man's station being forward or aft near the batteries, had no relation to the severity of his illness; for example, the two captains had sleeping bunks just above the battery boards and neither felt bad enough to go sick on return to harbor. This all points to individual idiosyncrasy as the cause of mild or severe symptoms since all the men probably inhaled an equal volume of the gas. In some cases the greater part of the inspired gas may have been absorbed by the lung epithelium, while in others most of the gas may simply have been exhaled again, or considering the minute quantity that must have been present and the well-known difference in the rate of excretion of arsenic in different people, the men with mild symptoms may have got rid of the gas as quickly as they absorbed it, while severer cases fixed a considerable proportion in their systems. The estimations of arsenic in the hair support this view.

Two rather peculiar statements deserve mention. One or two ratings said they felt worse when they lay down in the boat. Arseniuretted hydrogen is heavier than air but in spite of this, for reasons stated, I do not think the air at the bottom of the boat could have contained more of it than the air higher up. Nearly all the men stated that their symptoms, especially nausea and dyspnea, were worse just after breaking surface and getting into the fresh air. I thought at first that this might be due to the decrease of atmospheric pressure lowering the oxygen capacity of an already anemic blood. But there is practically no excess of pressure in a submerged submarine, and it is probably analogous to a well-known fact in alcohol toxemia, *viz.*, a man, who may have shown no symptoms of drunkenness in a hot ill-ventilated room, will suddenly develop symptoms on coming out into the cold fresh air.

This series of cases differs in one or two points from any previously described cases of arseniuretted hydrogen poisoning that I could find. The best description

and summary of arseniuretted hydrogen poisoning that I have seen is one by Dixon Mann* (*Medical Chronicle*, 1895). He describes five cases and summarizes forty-six in all. They were all acute, due to a sudden big dose of the gas, generally in some trade process in which impure acid was used to dissolve zinc. The symptoms upon which special stress is laid and which occurred most generally, were vomiting with pain in the epigastrum, hemoglobinuria, jaundice and rigors. Though albumin and fatty casts were common, the urine became normal very quickly in those cases that recovered. In the few cases in which the blood was examined, the red blood corpuscles were reduced. The mortality was 36.7 per cent.

It is interesting to note how these submarine cases differ from those of the literature. The main symptoms are the same except that not one of my cases had rigors. Persistent albuminuria and mild neuritic symptoms, though fairly constant in this series, are not even mentioned in Dixon Mann's paper. The onset was delayed two or three days or even longer in some of these cases, whereas in the previously reported cases the onset was generally immediate, or at any rate occurred within ten hours. The dose of poison, though small, continued to be administered after symptoms started. There was no mortality. These submarine cases are therefore unique. Under ordinary circumstances there are probably no other conditions, except during service in a submarine, under which men could be exposed to the action of a virulent poison, giving rise to very unpleasant symptoms, and have to remain in contact with it. In any trade process, should the gas be evolved in a closed room, the workers would at once, at the onset of symptoms, remove themselves from vicinity of the gas and would not remain in contact with it for seven or eight days as these men had to do. These cases are therefore the only reported instances of a chronic or subacute poisoning with arseniuretted hydrogen. The main difference from the acute form of poisoning is that there is time to accumulate sufficient arsenic to superimpose the peripheral neuritis symptoms of chronic arsenic poisoning on the symptoms caused by the direct action of the gas on the blood. The cases occurring in D.3's third voyage correspond to the ordinary acute form, of which Case 28 is an example. This patient's symptoms were marked but he made a rapid recovery with no neuritic symptoms or albumin in his urine after the third day. If this third trip of D.3 had been continued it is quite likely that more severe, if not fatal, cases would have occurred, since the symptoms started earlier, were more general, and were temporarily more severe than those of the previous trips. These cases all recovered merely with rest, blood tonics, and fresh air; there seemed to be no indications for special treatment, though direct transfusion of whole blood is a point worth considering in a severe case.

In conclusion, one cannot help feeling there is cause to be thankful that no catastrophe occurred, and that no life was lost before the nature of this malady in the submarines was discovered. The previously reported mortality from this form of poisoning is 36.7 per cent., so one can imagine its effect if present in any quantity, instead of in mere traces, in a closed space like a submarine from which there is no escape. It is possible even to conceive of a submarine never returning, her loss put down to the act of the enemy or hazard of the sea, whereas in reality her whole crew perished from the effects of this deadly poison.

ADDENDUM

Inquiry was made by the firm which had installed the batteries in the submarines as to the possible origin of the arseniuretted hydrogen gas, and the following is the substance of their report.

The battery on Submarine D.3 was first charged in November, 1910, and that on D.4 in 1911. As the batteries had been in use continuously for over five years and no previous trouble had been experienced, it was naturally thought that some arsenic-contaminated sulphuric acid had been recently added to the cells. Samples of electrolyte taken from the batteries and subjected to Marsh's test did not show an arsenic reaction. A sample of strong acid was then taken from a carboy, stated

*At the time of writing I had not seen Professor Glaister's book on Arseniuretted Hydrogen Poisoning.

to be one of the batch from which the acid was obtained for topping up the cells when the poisoning had occurred. On applying Marsh's test only a slight arsenic reaction was obtained. Endeavors were made to detect arseniuretted hydrogen gas in the gases given off when the battery was charging, but these were unsuccessful. Removal of the battery from the boat in order to facilitate chemical investigation was decided on.

Meanwhile laboratory tests, introducing arsenic impurity in various amounts into the electrolyte, gave only slight traces of the evolution of arseniuretted hydrogen gas. It was observed, however, that the arsenic introduced into the electrolyte in considerable quantities, was for the most part deposited as a chocolate brown precipitate on the elements, separators, and container sides, which precipitate resisted the action of charge and discharge.

On testing the battery from D.3 from which the acid had been changed, it was found that the gases evolved on charging from nearly all the cells, produced an arsenic coloration on mercuric chloride paper. The next step was to examine the active materials and grids of the plates. The active material from both plates gave no indication of arsenical deposit, which disposed of the original suspicion that arsenical contamination of the topping up acid was the cause of the trouble, because from the experiments cited arsenical contamination in the electrolyte would have produced arsenical deposit on the plates.

The examination of the metallic portion of the plates showed 0.2 per cent. of arsenic, and proved this to be the source of the poisoning. At the time the grids were made, antimonial lead alloy was used. The original surface of the grid had been deeply corroded, the effect of which was to convert slowly the metallic lead in the alloy into insoluble lead peroxide, and enable arsenic to pass into solution. The rate at which the arsenic would pass into solution would be negligible until the gassing period of the charge was reached, at which point the corrosive impurities in the electrolyte, assisted by electro-chemical action, would dissolve the arsenic exposed by the corrosive action on the alloy. The arsenic dissolved in the electrolyte would be carried to the negative electrode in small quantities as dissolved, and there converted into arseniuretted hydrogen gas by the nascent hydrogen at this electrode.

The presence of an excessive amount of corrosive impurity can be easily accounted for by the fact that the electrolyte had not been changed since the battery was installed in 1911, hence the accumulation of oxyacids of chlorine, arising from the sea air, carried over during the ventilation. This explanation accounts for the fact that only very minute traces of arsenic could be detected in the electrolyte. It may be noted that under war conditions, it is not always possible to ventilate the batteries into the atmosphere for a short period after charging has ceased. Could this always be done it would, in all probability, prevent any arseniuretted hydrogen getting into the interior of the boat, as gas is only evolved during charge, and only occluded gases come off for a short period after charging is stopped.

In the later batteries, as in those of the submarine class E, the grid castings were made of an alloy made from lead and pure antimony, instead of the antimonial lead alloy. In recent years antimony of high purity has been obtainable commercially. It was therefore not expected that any repetition of the trouble would be experienced, and actual tests made on the gases from many of the E class batteries do not show the presence of any arseniuretted hydrogen gas.

When the source of arsenic was discovered, all the batteries on the submarines of classes C and D were removed.

A PRACTICAL STUDY IN INDUSTRIAL FATIGUE *

Henry C. Link, Ph.D.

ORIGIN

THIS study was undertaken at the request of a large manufacturing concern in order to determine certain facts regarding the effects of fatigue on the work of shell inspection. A quotation from the letter which initiated the study will indicate the practical problem: "One of our most serious troubles recently has been defects in cartridges which might have been caught by the shell inspectors had their work been of a better quality." It was of the utmost importance at the time this study was undertaken to combine a maximum quantity of production with a maximum of quality. Therefore, the hours and conditions under which the work of inspection was being done were matters of great solicitude. The ten-hour day was in vogue, with a half holiday Saturdays.

For the sake of clarity it is necessary to explain briefly the work in question. All cartridge shells, before being loaded, must be given a very careful visual inspection. This work was being done by about 150 girls, in a large, well-lighted shop, under uniform conditions. Each girl sat before a hollow table, upon which was dumped a large box of brass shells. The inspector would pick these shells up, using both hands, and inspect them for a variety of defects. The defects to be looked for were often very small. Defective shells were thrown into small boxes, and the good shells were dropped through a chute into a large box below. It is apparent that the work was very light from the standpoint of the muscular energy expended, but quite strenuous in the steady and continuous attention which it required. The work was done on a piece-work basis, with an extra 10 per cent. and 20 per cent. bonus for doing more than a certain number of pounds of work (shells) per day. Each box of shells, after it had been inspected, was reinspected by a check-inspector, who sampled a certain number of the shells in the box. If this reinspection showed a certain number of defective shells still present, the entire box was sent back to the girl responsible, and she had to inspect the box again, this time without pay.

METHODS OF APPROACH

This study was conducted from four different angles:

(1) By means of a reinspection,

(2) By means of psychological tests,

(3) By means of a careful production study,

(4) By means of ordinary observation.

REINSPECTION

An impression existed that the quality of the work done during the latter part of the day was greatly inferior to the quality of the work done during the earlier hours, so inferior, in fact, that it did not pay to work during the last hour or two, between 4 and 6 o'clock. Another large company, acting on this assumption, had taken some of the shells inspected by their girls after 5 o'clock and unknown to the girls themselves had returned them for reinspection the following morning. A surprising amount of "scrap" (defective shells) was found. On the strength of this test, the hours for inspection at this plant were reduced from ten to eight and one-half. A similar experiment had been tried here and a considerable amount of scrap had been found. Consequently, there was a tendency to take the same step here in reducing the length of the working day. Obviously, there was no justification for such a decision, for the tests made proved nothing whatsoever about the comparative quality of the work done at *different* times of the day.

The method used in this study was as follows: A number of boxes of shells which had been inspected the first thing in the morning were separated and returned, surreptitiously, to the same girls for reinspection later in the day. This was also done with boxes inspected by the same

*The conduct of this study was shared equally by Mr. John L. Koehne, A. B., Miss Marion Gilbert, A. B., and the writer. Received for publication June 2, 1919.

girls between 5 and 6 P. M. and between 1 and 2.30. In every case, the scrap thrown out at the reinspection was saved and analyzed. Only ten boxes were handled at a time, to avoid interfering with production, and also in order to make a wide distribution of the samples. The reinspection was done at different times of the day, in order to distribute the possible sources of error. The scrap found in all of these boxes was totalled and averaged with the following results:

	Time of Original Inspection		
	7-8 A.M.	1-2.30 P.M.	5-6 P.M.
Number of Boxes Inspected	17.0	26.0	37.0
Percentage of Total Scrap Found by Reinspection	12.2	8.5	15.5
Percentage of Scrap (Based on Total Number of Shells Inspected) Found by Reinspection	3.9	2.6	5.3

From the above it will be seen that 3.3 per cent. more scrap was overlooked between 5 and 6 in the afternoon than was overlooked between 7 and 8 in the morning, and 7 per cent. more than between 1 and 2.30. These variations are not quite so great when figured on the basis of the total number of shells in an average box. Computed in this way, the percentage of scrap overlooked at night is 1.4 per cent. of the total number of shells more than in the morning. This increase was comparatively slight and could have been easily overcome by requiring the check-inspectors to sample the boxes more thoroughly in the evening than during the early part of the day.

PSYCHOLOGICAL TESTS

As a result of experiments of a somewhat similar nature carried out elsewhere, it was thought possible to obtain a gauge of fatigue by means of psychological tests. This would have been very desirable because of the high degree of accuracy which the psychological method possesses, as contrasted with other less scientific methods of observation. Therefore, three tests were selected for this purpose. The first of these was the Woodworth-Wells Number Group Checking Test (a paper on which is printed over 100 groups of numbers), in which the inspectors were asked to check off all the numbers which contained both a "1" and a "7". This test is one which had been previously tried out and had proved valuable in the selection of inspectors.* The second test was a Dot Counting Test. A sheet of paper containing eighteen groups of dots arranged in irregular order was presented to each girl and she was required to count the dots in each group and put down the number. The third test was a simple one. It consisted of twenty-five lines of punctuation marks, numbers, and letters arranged in heterogeneous order. The task was to count only the dots in each line and put the number at the end of the line.

The next step was to select a group of inspectors to whom these tests should be given. Forty girls were selected. They were chosen partly on the basis of attendance, partly on the basis of length of service. Only girls who had been regular in attendance were chosen because it would have been obviously impossible to make a good fatigue study on subjects who were absent from their work a good part of the time. The girls were grouped in one part of the shop so as to facilitate giving the tests. The three tests were given to the forty girls at one time and without taking them from their work. The manner in which this was done was as follows:

Whenever the tests were given, each girl was provided with a little writing board, a pencil, and a copy of the tests numbered in their proper order. When these had been distributed and the inspectors had had an opportunity to get their boards into position, they were given the signal for the first test by means of a

*Details of the method by which psychological tests are developed and applied to particular kinds of work are to be found in the writer's book, *Employment Psychology*, The Macmillan Company.

shrill whistle. After two minutes the whistle was blown again, which meant, "Stop the first test and get ready for the second." After an interval of thirty seconds the second test was started in the same way and then the third test. The completed tests, pencils, and writing boards were then collected. The time occupied by this entire procedure was just about twelve minutes. Three people were required to carry out this work.

The three tests were given to the entire group of forty girls five times a day, first at 7.10 A. M., then just before 12.00 M., at 1.10 P. M., 4.40 P. M. and 5.40 P. M. They were given in this way for a period of three weeks, which means that a total of about 12,400 tests were given.

During the first week or two the girls improved so rapidly in the tests that no consistent effects of fatigue were apparent. After the first ten days, however, the effects of practice became less marked. The performances for the last nine days, therefore, were computed, with the results indicated in Figure 1. It developed during the course of the study that Test 3 was not printed clearly, and therefore the results in this test were abandoned. By referring to Figure 1 it will be seen that the percentage of errors bears a marked resemblance to the percentage of scrap found in the reinspection. The lowest number of errors occur at noon and there is a slightly higher percentage of errors at night than in the morning. However, the percentage of errors is in all cases extremely low, ranging from 2 per cent. to 5 per cent.

An entirely unexpected and unorthodox result is the record of the performances in the evening. Instead of a marked falling off in the quantity done at the end of the day, as might be expected, there is even a slight increase. This is entirely at variance with the popular notion of the effects of fatigue as well as with the more scientific theories on fatigue which have been advanced to date.

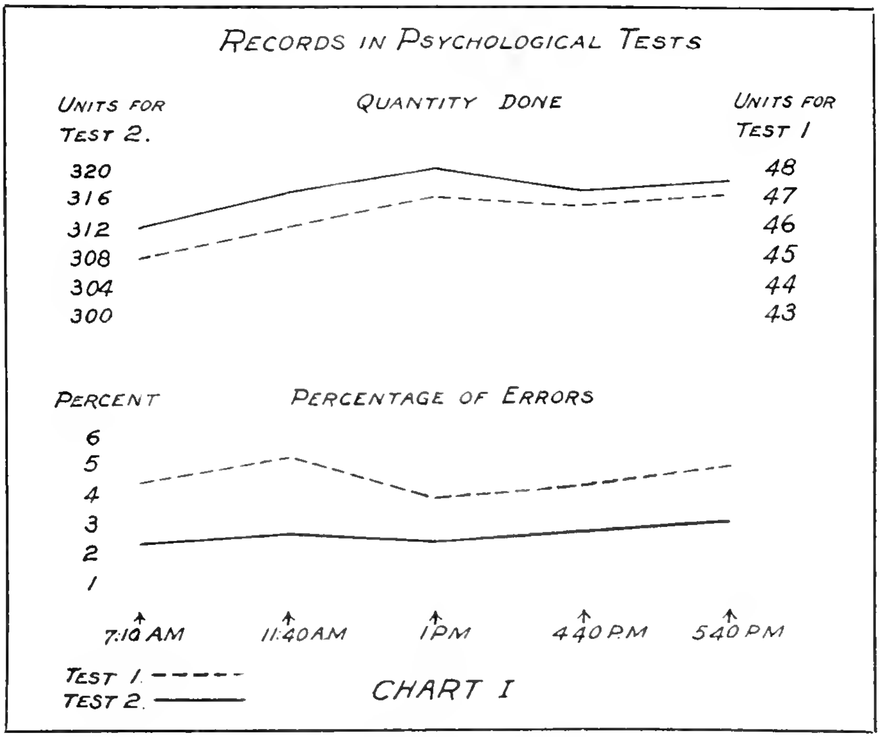

FIG. 1.—The curves represent the average performance in the tests of the entire group, at the various times of day indicated by the horizontal row of figures.

PRODUCTION AS AN INDEX OF FATIGUE

At the conclusion of the above study a careful production study was undertaken. This was done in order to determine the amount of work done at various times of day. Some thirty to forty experienced inspectors were timed, box by box, throughout the entire day for a period of three weeks. The weight of each box before and after inspection was taken. In this way it was possible to compute the average rate of production for each girl individually, as well as for the group as a whole, for each period throughout the day. The method adopted was to take the average rate of production for the entire group during each of the ten different hours of the working day. To be sure, not all boxes were finished on the hour. The boxes were

therefore attributed to the period within which more than half of the time taken fell. The rates of production for each of the three weeks studied, for the entire three weeks, and the average rate of production for the morning and afternoon are plotted in Figure 2.

It will be seen that the curves of production are quite consistent but it will also be seen that these curves do not bear out the traditional and hypothetical curves which have been presented as applying to work of this kind. According to the generally accepted notion of fatigue, the curves for work similar to inspection should be somewhat as shown in Figure 3, that is, a slight rise immediately after work has started in the morning and then a gradual falling off, then a considerable increase immediately after luncheon and a more sudden decline during the afternoon, with the lowest point at the end of the day.

No detailed, comprehensive study published up to the present time has demonstrated the correctness of these assumptions. The results of the present study certainly failed to bear out their soundness. In the first place, instead of a short rise in the morning and in the afternoon, there was a prolonged rise; instead of an increase in production immediately after luncheon, there was a decided drop; instead of a consistent decrease in production with the lowest point at the end of the day, there was an intermittent increase with the highest rate of production during the last hour of the day. The last fact is very striking in the face of all expectations and prophesies to the contrary. Superficially, it seems almost like a violation of physiological laws.

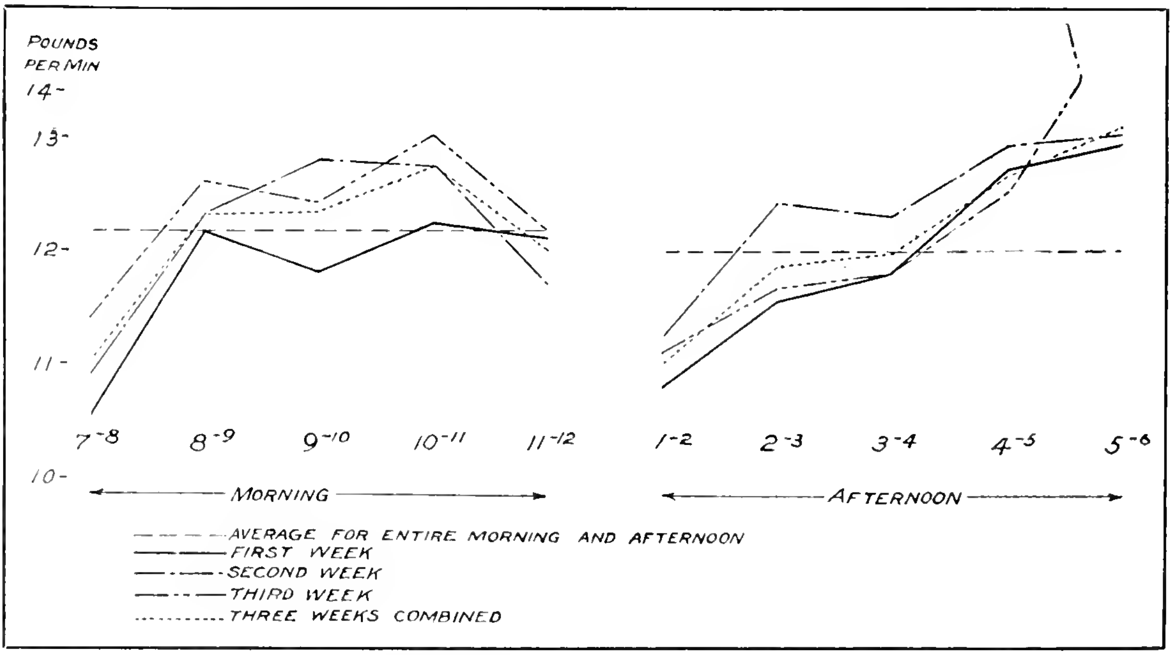

FIG. 2.—The uneven curves show the average rates of production (pounds per minute) of the entire group at the times of day indicated by the horizontal row of figures. The straight lines show the average rate of production for the morning and afternoon during the entire three weeks.

OBSERVED FACTS

In addition to the facts noted above, a careful observation was made of several contributing factors, such as temperature, ventilation, illumination, and general shop conditions. In so far as the factors observed could be interpreted, their effect should have been to retard production toward the end of the day. There was a slight increase in temperature—about two degrees—and a slight decrease in the quality of the light and ventilation. Although these observations led to several practical recommendations, they could not be connected with the changes in the quality and quantity of production without a great deal of ambiguity.

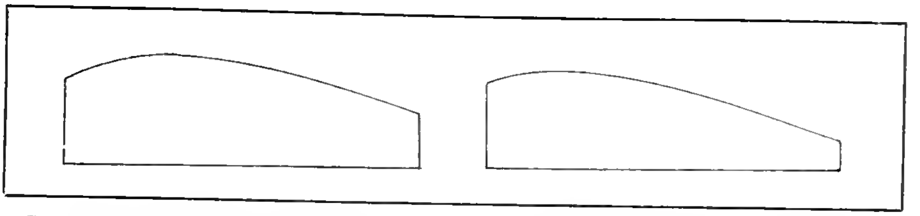

FIG. 3.—These curves indicate the traditional view regarding the rates of production during morning and afternoon for work like that described above. The horizontal distances indicate time of day; the vertical distances, rate of production.

CONCLUSIONS

a. *Reinspection.*—The reinspection described above showed that there was not enough difference in the quality of the work done at various times of the day to justify reducing the number of hours.

b. *Psychological Tests.*—The results in the tests, in so far as they were indicative, coincided largely with the results of the reinspection and production study. However, the variations in the quantity and quality of the work done in these tests were altogether too slight to justify using them as an index of fatigue. On the other hand, the variations due to practice were so marked as to make all other variations seem insignificant. This is not necessarily a repudiation of the psychological method, but rather an indication of the difficulties involved. It would seem that two-minute tests are entirely too short for reliability, even if carried on five times a day for a period of three weeks. Moreover, as has since been discovered in connection with the development of psychological tests for aviators, the human mind is able to concentrate for short periods even when it is almost on the point of exhaustion and render for such a time a performance which compares favorably with those done under the most favorable conditions.

c. *Production Study.*—The most conclusive results were obtained by this study. Various reasons may be given for the increase in production toward the end of the day.

(1) Each inspector desires to do a certain number of pounds of work per day, and as 6 o'clock approaches it becomes more and more necessary for her to speed up in order to make up for lost time.

(2) The offering of a 10 per cent. and 20 per cent. bonus for reaching a certain quota adds still further to the strength of this stimulus. Such a bonus produces an increase of exertion as the goal is approached, similar to the sprint of a runner when the end of his last lap is in sight.

(3) The effects of practice and rhythm are cumulative. As the day wears on the inspectors gradually hit a better and better pace. This is also the opinion of the foremen. In spite of these facts, however, it will be seen that the average production for the entire afternoon is slightly lower than the average for the entire morning. (See dotted black line.)

From the results of this study it cannot be definitely concluded that an eight or nine-hour day would either increase or lower the rate of production. In order to arrive at such a conclusion it would be necessary to try out the shorter day under identical conditions,—a course which it is practically impossible to follow. A year before the time of the present study it was found that forty shell inspectors did 3.2 per cent. less work per hour after the length of the working day had been reduced from ten hours to eight and six-tenths hours. This carefully checked up data, while not absolutely conclusive, shows at least that a shorter day does not *necessarily* mean an increase in the rate of production.

It was concluded that the ten-hour day *per se* did not produce enough fatigue among shell inspectors to prevent them from doing more work in the last part of the day than they did in the morning, directly after luncheon, or at any other part of the day. Whatever significance the psychological tests had, tended to corroborate the results of the production study.

This study was conducted without any preconceived theories regarding the relative merits of an eight or ten-hour day. Indeed, the writer does not entertain the notion that the results of this study or of any similar studies will have much effect on the final outcome of this problem. It is believed that, in the end, ethical consideration and not considerations of efficiency will decide what the length of the working day shall be. In this particular case efficiency was the prime consideration and it was therefore possible to make a practical study with this as the determining factor.

A STUDY OF FIFTY WORKERS IN TRINITROTOLUENE *

Tracy Jackson Putnam, A.B.

and

William Herman, A.B.

As a part of a general survey of trinitrotoluene manufacture in the United States, we made a study of fifty partially selected men engaged in purifying and packing the material at a plant on the Atlantic slope, during the month of September, 1918. This survey was undertaken for the purpose of determining more exactly the symptoms of poisoning by the chemical, and its usual path of absorption and pharmacological action, as a step toward the early diagnosis and prevention of its harmful effects upon those handling it. In addition, it was hoped that the study of the manifestations of disease produced by a known toxic agent would help to throw some light upon the nature of clinically similar manifestations in diseases of unknown etiology. We were directed and much aided in our work by Dr. Alice Hamilton and Dr. George R. Minot.

The process in which our subjects were engaged was as follows: The crude acid trinitrotoluene, in large lumps, was shipped to the plant in barrels from the nitrating works. These barrels, usually covered with the material, were rolled by hand across a broad platform and dumped through a grating into an elevator, which transferred them to the great boiling tanks. In the tanks, the explosive was washed for some hours with hot water, stirred by steam jets, to remove the acid. The boiling was a clean process; little was spilled, and there was little dust or vapor. The inside of the tanks occasionally had to be cleaned, however, which involved much contact with the wet material and with the fumes.

When sufficiently washed, the molten trinitrotoluene was allowed to flow into large iron "eggs", from which it was blown by steam pressure into another tank in the graining-houses. The grainers consisted of low round iron vats, slowly but continuously stirred by a revolving dasher. There was a hood and draught chimney several feet above each. In these vats the hot chemical was allowed to cool and crystallize into a coarse yellow powder, the process taking about eight hours. This powder was then transferred with wooden shovels to barrels, which were loaded upon a "dinkey" train. The fumes were noticeable about the tanks while the trinitrotoluene was being poured out, but the shed in which they stood was open and airy. A good deal of material was spilled on the floor or sublimed about the walls. To remove it the entire building was scraped or hosed with live steam every few weeks, which produced so many fumes that it was considered a dangerous job. The barrels and utensils were caked with trinitrotoluene also and considerable dust was raised in handling them.

The barrels of powder were next transferred to the dumping-room on the second floor of another building, the packing-house. They were inverted on a grating over the floor and pounded to dislodge the contents. The powder was brushed through a revolving screen and descended through a funnel into shipping-cases, which were packed, weighed, and loaded by hand. Throughout the packing-house there was constant contact with the powder and much dust, but there were practically no fumes.

Waste and scrap from all over the plant was remelted and crystallized separately in a small open vat. This "pelleting" plant was practically out of doors; nevertheless, it involved considerable contact with trinitrotoluene and the fumes were heavy.

The men in the boiling and graining-houses worked in three eight-hour shifts: the packers, dumpers, and pelleters worked ten hours a day. About half the employees slept in the company's bunk-houses. There was a cafeteria not far from the works, where they could go for

*This work was undertaken under a grant from the National Research Council. Received for publication June 11, 1919.

lunch or could get food to take out. They were furnished with as much milk as they wished, free. Labor was very scarce, and the men seemed to prefer the work on smokeless powder to the much lighter jobs on "T.N.T."

THE SYMPTOMS OF MILD TRINITROTOLUENE POISONING

Reasonably comprehensive histories were taken from the workers whom we interviewed, concerning any symptoms possibly referable to poisoning which they had experienced since working with trinitrotoluene, their age, general condition, and habits of life in so far as these had a bearing upon their exposure to poisoning. In arranging the symptoms, we have adopted a modification of Livingstone-Learmonth and Cunningham's (1) classification. These authors, who, in an able paper, give a clinical account of the poisoning which includes practically all of the symptoms observed by later writers, group the symptoms as follows:

1. Irritative Symptoms:
   a. *Respiratory:* Nasal discomfort, sneezing, coryza, epistaxis. Smarting and watering eyes. Frontal headache, perhaps due to nasal obstruction. Sore throat. Tightness and pain in chest. Dry cough.
   b. *Gastro-intestinal:* Constant bitter taste. Spasmodic epigastric pain. Nausea and vomiting. Acid eructations. Constipation, then diarrhea; cramps and griping.
   c. *Cutaneous:* Various rashes.
2. Toxic Symptoms:
   a. *Gastro-intestinal:* Bilious attacks, nausea, vomiting, anorexia, constipation, jaundice. Dull pain behind ensiform.
   b. *Circulatory:* Faintness, giddiness, flushes, pallor, cyanosis, bradycardia, palpitation, air-hunger, swelling of extremities, non-traumatic bruises.
   c. *Nervous:* Drowsiness, apathy, loss of memory, blurring of vision, peripheral neuritis. As a terminal event, delirium, coma, convulsions.
   d. *Special:* Irregular menstruation. Dark, scanty urine, dysuria.

Symptoms apparently referable to irritation of the respiratory system were not prominent in our series of cases, and did not seem to appear as early as in some groups which have been studied. Eight men complained of a feeling of tightness in the chest, usually accompanied by cough, coryza, or sore throat. Smarting and watering of the eyes occurred in seven cases. Some of these men had no other symptoms; others were fairly sick. The respiratory discomfort in itself was not serious.

The symptoms of gastro-intestinal irritation—bad taste in the mouth, anorexia, diarrhea, cramps, constipation, nausea, and vomiting—appear early in those exposed to trinitrotoluene. Fifteen reported a loss of appetite, and twenty-five a bitter taste in the mouth. Nineteen had had diarrhea, ten constipation, and five abdominal cramps. All of the above mentioned symptoms had appeared during the first three weeks of exposure. Ten of those affected with these milder symptoms had experienced attacks of nausea; and seven, attacks of vomiting. The nausea and vomiting usually appeared from ten days to two weeks after the milder irritative gastro-intestinal symptoms had been experienced, and apparently indicated a much more severe form of poisoning as they were almost always accompanied by symptoms referable to other systems. The physical examination and laboratory findings usually confirmed this impression.

Thirteen men reported cutaneous irritation, coming on during the first three weeks of exposure, usually during hot weather. We saw a few cases of this dermatitis, which will be described later. All of the men in this group had had the milder symptoms of gastro-intestinal irritation during the same period but, with one or two exceptions, they did not seem very sick.

The importance of evidences of renal irritation does not seem to have been brought out by earlier observers. Eight of our men gave a history of polyuria, which was marked in some cases; and of these, six had urgency of micturition as well and two a possibly suggestive lumbar pain. These symptoms did not appear in less than two weeks in any of our cases, and were usually accompanied by other evidences of poisoning. The scanty urination reported by Livingstone-Learmonth and Cunningham was not seen.

The "toxic" symptoms may be divided into the gastro-intestinal, the circulatory, and the nervous. Whether they are really due to the toxic effect of the chemical on these systems is, perhaps, open to doubt. We rather believe that the majority of them may be explained by the loss of oxygen-carrying power of the blood, which

is indicated by the laboratory examinations. That true degeneration can be caused in parenchymatous organs, however, is shown by the occurrence of atrophy of the liver in the fatal cases of poisoning.

The only symptoms which appeared to us definitely referable to toxic action upon the digestive tract were those which might indicate liver involvement: pain and tenderness in the right epigastrium, especially when accompanied by nausea or vomiting. Five workers reported epigastric pain, and physical examination revealed a palpable liver in two of them; both were seriously poisoned men. The other three had the symptoms of mild poisoning only. Liver involvement is, of course, the most dangerous effect of trinitrotoluene poisoning, except perhaps the rarer aplastic anemia.

The circulatory symptoms, dyspnea and dizziness, were prominent in our series, being present, usually together, in fifteen cases. All of the men so affected had previously had the milder, and some, the severer gastro-intestinal symptoms. Practically all showed macroscopic hemoglobin change, and red cell changes in the stained blood smears.

The nervous effects may be divided into those apparently central and those apparently peripheral. Of the cerebral effects, drowsiness or easy fatiguability has been noted by all observers. They occurred, usually together, in sixteen of our cases, usually the more severe ones, and varied from a weakness in the legs when climbing stairs to a constant depression. Headache was reported by about the same number of patients, but often with very few other symptoms. Dizziness was spoken of by sixteen men, and was marked in some instances. It was associated with headache in about half the cases. The cerebral group of symptoms came on rather later in our series than in some others—rarely before the second week.

The manifestations of the "peripheral neuritis" of Livingstone-Learmonth and Cunningham were extremely interesting. The most important was a curious "tired pain in the back of the knees," almost always described in those words. It occurred in ten men. Twitching of muscles, especially of the legs, was reported by four of our subjects; other workers in this same survey have also had cases of it.

Practically all of the men showing marked nervous symptoms were deeply cyanosed and smears of their blood showed red cell changes. We are inclined, therefore, to believe that such symptoms may be regarded as secondary to the blood changes.

From the above findings taken in connection with those of other workers, we have concluded that symptoms confined to the gastro-intestinal tract are of little consequence when found alone; that the same is true of irritative skin lesions; that symptoms of blood involvement show a marked stage of intoxication, whether occurring alone or accompanied by other manifestations; and that renal, and particularly liver manifestations, are indicative of a more profound and dangerous intoxication.

The epistaxis, bradycardia, air-hunger, palpitation, swelling of extremities, ecchymosis, scanty urine, blurred vision, loss of memory, convulsions, and coma, spoken of by the English writers (1), were not encountered although asked for. Six men had had practically no symptoms; of these, three had worked less than a week, and one was a foreman, who was but little exposed.

FINDINGS ON PHYSICAL EXAMINATION

The appearance of every one of the men who actually handled trinitrotoluene was striking, as all who have seen them remark. Except for two or three of the foremen, who carefully avoided all contact with the powder and observed most scrupulous cleanliness, every worker's hands were stained an orange color, varying from a delicate lemon to a deep ochre. Merely picking up a single fistful of the powder left a perceptible yellowing, which persisted for a day or two in spite of soap and water, leaving the skin rather hard and brittle, much as will a very slight nitric acid burn. Possibly a part of the stain is due to retained acid. Gloves of leather or canvas did not prevent the soiling of the hands, for the fine powder always sifted in around the wrists. The hair and beards of many of the men, especially of those with light complexions, often took on a reddish chestnut brown. Often the face, upper arms and chest would be lightly yellowed from deposited

dust. Where the skin was not stained, it was usually pale and sallow; and especially in those most saturated with the stuff, the whole face had a characteristic wizened, grayish-yellow look. The Medical Research Committee of the National Health Insurance (Great Britian) (2) mentions such an appearance as being of value in the diagnosis of serious poisoning and, in general, the degree of pallor did seem to us to correspond roughly with the severity of the case. We made special note of the grayish-yellow pallor in eleven cases, and none of the white men whom we considered the sickest were without it; in the negroes, of course, it was difficult to make out. On the other hand, several of those in whom it was marked seemed otherwise well.

More significant, as the English writers agree, was the color of the mucosae. In only ten of the subjects was the color noted as within normal limits; of these, two had been at work for only one day, and one was a foreman who came but little in contact with the material. In thirty-three a distinct bluish coloration was made out, varying from a slight purpling to a pale slate gray. The men whose lips showed such a slatey blue were as a rule the sicker ones, but by no means invariably. Five looked merely pale, without any cyanosis, but an examination ot the blood showed that they were not distinctly more anemic than the rest.

A slight yellowing of the sclerotics, apparently not due to jaundice, but to a uniform deposit of fat, was observed in all of the negroes examined except one, and we came to regard it as not abnormal in that race. Slight jaundice occurred in two white men, one of whom had a palpable liver and other signs which we considered to indicate severe poisoning, while the other appeared but little affected. True jaundice is, of course, a prominent feature in all the later cases of liver degeneration and seems, therefore, an important sign in all.

Panton (3) remarks that many of the men he examined who had not begun to work on trinitrotoluene, had a slight yellowing of the sclerotics, which he attributed to constipation. Both he and Pillman (4) believe that little weight can be attached to mild jaundice in the diagnosis of trinitrotoluene poisoning, but perhaps there may be a difference of opinion as to what constitutes definite jaundice.

Nine cases of dermatitis were seen. The eruption consisted of rather close-set, discrete, pin-head sized papules, usually rather red. Its favorite location was the extensor surface of the forearm, though it sometimes occurred on the back of the hand and about the face. The lesions itched, but not severely. The pompholyx type of lesion, crusting, and "lichenification," spoken of by the English writers (1) (5), were not seen; however, all those who have reported dermatitis agree that it is worse in hot weather and the temperature was moderate all through our period of observation.

Tenderness and spasm in the epigastrium was found in eight cases. In three of these, it was probably due to passive congestion of the liver, since valvular disease of the heart was found, or possibly the circulatory disturbance made the organ more susceptible to poisoning. In some of the remainder, the tenderness may have been neurotic in nature, but, on the whole, it was most marked in those who had clear symptoms and signs of poisoning elsewhere. In two of the men, the liver was distinctly palpable below the costal margin, although no cardiac lesion could be found. An enlargement of the liver is a most definite evidence of degeneration and should be a signal for removal of the man from work. Both of our cases had many other symptoms of poisoning.

For the rest, the physical examination was essentially negative. The tongue was usually clean. The teeth were bad, as a rule. In nine men, valvular disease of the heart was found—a rather high incidence, due perhaps to the fact that many had been refused for the army. The lungs were normal in practically all cases. The knee-jerks and pupillary reactions were within normal limits in every case. The pulse ranged from 62 to 104; its quality was not remarkable. The respirations per minute were from 12 to 28; the higher rates occurring in cases of heart disease. The temperatures were all between 97° and 99°F. Blood pressure was apparently unaffected by the substance; the highest systolic pressure was 155 mm., the lowest 105 mm., and the figures varied, in general, with the age of the subject. On two occasions, we took the blood pressures of

a series of fifteen men before starting work and again at the end of the shift. The average of the former readings was 119.5 mm., systolic; 83, diastolic: and of the latter, 120.6 mm., systolic; 84.4, diastolic. Examination of the blood pressures of three men just before and just after steaming out a tank—a very dirty job—also showed no noteworthy variation.

LABORATORY FINDINGS

A sample of urine was obtained from almost every subject and, whenever possible, two samples, one passed in the evening, and one in the morning. The conditions under which we had to work made it impossible to collect any twenty-four hour amounts. The color, reaction, and specific gravity were noted in most cases, and the Webster test (6) for trinitrotoluene products was done as routine. In a good many samples albumin was tested for by the nitric acid method and sugar with Benedict's solution; in a few, the sediment was examined. Ehrlich's test for urobilinogen was done, or the sulphates were determined by the centrifugal method.

The Webster test was considered the most important part of the urine examination by the English workers, since it is characteristic and constant in practically all cases of poisoning. It consists in shaking together 10 c.c. each of the urine, 20 per cent. sulphuric acid, and commercial ether; allowing the liquids to separate, and drawing off the aqueous layer. The ethereal solution is again shaken with 20 c.c. of tap water, and again decanted. To it is added 5 c.c. of a 5 per cent. solution of caustic potash in denatured alcohol. An orange or purplish coloration, changing to a dirty brown, is a "positive" reaction, and the relative intensity of the reaction may be indicated by calling it from one to five plus. The color is much like that obtained by making alkaline a dilute solution of trinitrotoluene in alcohol; moreover, the crystals which we obtained by allowing an ethereal extract of a good "positive" urine to evaporate on a slide had a form very similar to, if not identical with, that of pure trinitrotoluene crystals. Moore (2), however, declares that the substance in the urine is a reduction product of trinitrotoluene. The urine before being acidified gives no coloration with alkalies, unless it has been contaminated. The test is practically specific and can be made absolutely so by adding caustic potash to an ethereal extract of the unacidified urine, as its originators observed, to detect contamination from the subject's hands or clothes, or by microscopical examination of the crystals deposited from ether. While such precautions are seldom necessary, it must be remembered that a case has been reported (7) in which a false reaction was given by rhubarb administered to the patient, and some of the other anthracenes or other substances might have a similar effect.

We attempted to devise a method for making the Webster test quantitative by subjecting a standard solution of pure trinitrotoluene to the same series of manœuvres used in the usual test and using it as a colorimetric standard. We found that a 0.1 per cent. alcoholic solution was stable and that more dilute standard solutions in water could be easily made from it by adding potassium hydroxide in excess. Such alkaline solutions were fairly comparable with the ether-alcohol-water solution obtained as an end result of the Webster test on urine if the latter were diluted two or three times. They faded rapidly, however; and other factors, such as the evaporation of the ether, the presence of particles in suspension, and so on, made the technique so formidable that we abandoned it after a few trials. We determined, however, that a "three-plus" urine contained about 0.03 per cent. trinitrotoluene; what the twenty-four hour amount may be, we have, of course, no means of knowing. If it were ever essential to quantitate trinitrotoluene in urine, a modification of the iodine method for nitro derivatives might be used (8).

The Webster test is, then, an index of the amount of trinitrotoluene which is being excreted in the urine. Moreover, the kidneys appear to be the chief, if not the only path of excretion of the material. The stools from three of our severest cases were negative by the Webster test, which was not the experience of the English observers (5); and although workers speak of seeing pink spots under the arms of their underclothes after laundering, suggesting elimination in the sweat, the amount thus disposed of cannot be very

considerable. The test may be negative in one specimen of urine and very positive in a specimen passed eight or ten hours later; it is usually much more positive in samples made at the end of the day's work than in those voided in the morning; which indicates that the trinitrotoluene is usually disposed of rather rapidly.

If, then, we assume that the severity of the symptoms produced by the chemical is proportional to the amount present in the body, we should expect the severest cases to be associated either with a very positive Webster, indicating a high rate of absorption, or with a slight or negative Webster, indicating faulty excretion. But we were unable to make out clearly any such relation. On the whole, the men most affected by the trinitrotoluene had higher Websters than the others. But some of our severest cases showed a less intense Webster than others practically free from significant symptoms or signs. The men who kept their hands clean gave slight or negative tests; most but not all of those who were personally dirty had high tests.

The color of the urine was noted as darker than normal at some time in thirty-nine of the cases. It ranged from a scarcely abnormal amber to a fairly deep red, like port wine, and some men gave a history of having noticed a difference in the color. The intensity of the color increased on standing but was not influenced by the reaction of the urine. We were not able to account satisfactorily for the coloration. The specific gravity tended to be high, up to 1.038 in two cases, and usually between 1.020 and 1.030. Both color and specific gravity varied directly with the intensity of the Webster test in most instances.

An unexpected finding was that Benedict's qualitative solution was reduced by those urines which gave an intense Webster. In four specimens in which reduction was pronounced, however, the addition of yeast caused no evolution of gas or change in specific gravity after incubating; and reduction still could be obtained. We were unable to reduce Benedict's solution with weak solutions of alkaline trinitrotoluene, and we, therefore, came to the conclusion that the oxidizable substance was probably glycuronic acid. The urinary sulphates, which we expected to find increased from analogy with the conditions in phenol poisoning, were well within normal limits in the four instances in which they were determined.

For the rest, the urine examination was not remarkable. The reaction was usually acid. Albumin was present in small amount in three cases, absent in fourteen; it did not appear to have any connection with poisoning. The sediment was negative in the seven cases in which it was examined. The test with Ehrlich's reagent gave no evidence of the presence of urobilinogen, which the condition of the blood led us to believe might be present. Bile was never found.

Stool examinations were done in three of our most severe cases but we were unable to demonstrate trinitrotoluene in any of the specimens. This is not in accord with the findings of the Ministry of Munitions Committee (5).

Several investigators have suggested that the condition of poisoning is associated with an acidosis. To test this point, we tried Sellard's test on five of our more severe cases. Ten grams of sodium bicarbonate are administered, and the urine collected two hours later; if it is acid in reaction, the alkali reserve of the blood is probably reduced. Four of our men showed an alkaline reaction; one an acid reaction. We were inclined to attribute the latter result to a failure to follow directions, and to believe that an acidosis is not a feature of the earlier stages of poisoning.

THE BLOOD

Of all the laboratory examinations, we believe that that of the blood gives the most definite evidences of the poisonous effect of trinitrotoluene and agrees most satisfactorily with the subject's condition clinically. The importance of the study of the blood is well brought out in Minot's analysis of 233 cases (9), among which ours are included and to which we refer the reader. Our series contained representatives of all of his classes.

THE PATH OF ABSORPTION

The determination of the path of absorption of trinitrotoluene is an essential step toward devising intelligent measures of preventing poisoning. In investigating it under working conditions, one thinks first of the inhalation of fumes and dust. The sweetish, irritating odor is perceptible all

through the grounds of the plant. Both purifying and graining the material involve the use of heat and the tanks are by no means tight. The material is transferred in a molten condition from one building to another by steam pressure, and at the outlet and at any leaks or holes in the pipes it may be seen to sublime out in flat sheaves of glistening, yellowish, acicular crystals. The workmen, also, believe that inhalation of finely divided material is productive of poisoning. One veteran at the trade always wore a rubber filter, which he provided himself. The most feared procedure was cleaning out the bottoms of the great tanks in which the crude product was boiled. The heat, moisture, and smell in them was almost overpowering and many of the men refused point-blank to enter them. We heard from several witnesses stories of how men would faint and grow blue in the face during the process of cleaning the buildings, which was done by volatilizing and melting with live steam any of the explosive that had been spilled. Our most severe cases came from the screening and packing-house, where the air seemed filled with a fine powder; and from the pelleting-plant, where waste material was recrystallized in an open vat.

We were, however, forced to the conclusion which Moore and his co-workers (10) had already reached, that poisoning by way of the respiratory tract rarely, if ever, occurs. The amount of trinitrotoluene indicated by a strongly positive Webster seems too great to have been absorbed through the lungs alone. One of us remained in one of the boiler tanks for a half an hour during the process of cleaning, which should constitute a severe exposure to fumes, without feeling any symptoms or producing a Webster in his urine. We were led, therefore, to repeat some of Moore's simpler experiments, namely, those of examining the air of the different buildings for trinitrotoluene. We constructed an apparatus to aspirate air through a small quantity of alcoholic solution of caustic potash, and thus examined 50 litres each from the worst corners of the graining-house and the screening-room, respectively. No change of color was produced in the alkali, although 0.005 mg. of crystalline trinitrotoluene is easily detected in this manner. The sensations produced by the smell were probably imaginary. The undoubted cases of syncope occurring during the "steaming-out" may well have been due simply to heat exhaustion. Or it is possible that the combination of heat and moisture favors absorption of the material, or that it produces symptoms in an already poisoned man.

The most important path of absorption is undoubtedly the skin, although a considerable amount may sometimes be taken in by mouth also. While we were unable to repeat Moore's ingenious and elaborate experiments, our observations were all in accord with this theory. The dirtiest men were, on the whole, the sickest; and none of the foremen who took pains to keep their hands clean showed any signs or symptoms at all, although they were often exposed to the fumes. Moreover, the danger from dust seems to be best explained in such a manner, for the clothes of the men who worked in the dustier parts of the plant were constantly saturated, and, since many of them slept in the same outfit, the chance of absorption was great.

Ingestion by mouth is also probably of some importance in the causation of poisoning. The danger seems to lie not only in eating lunch on the premises or with dirty hands, which is obviously dangerous, but also in chewing tobacco handled with fingers loaded with the chemical. The practice of chewing is very common, since the men cannot smoke, and some believe it is a prophylactic, in that it conceals the smell and taste and encourages spitting.

The effect of alcohol upon workers in trinitrotoluene is an interesting one, already remarked by several observers. Some men were able to drink without noticing any unusual symptoms, but from three or four, normally by no means easily upset, we heard some remarkable tales. The stories were much alike; after taking one or two small drinks, a man would feel dizzy, and often turn blue and faint, his pulse and respiration becoming rapid. There was also a rumor that if a man came to work the day after a "party," he was sure to get poisoned. We are inclined to believe the substantial truth of these stories, and to think it possible that alcohol being an excellent solvent for tri-

nitrotoluene, favors the absorption from the skin or perhaps mobilizes it in the body. A similar explanation may be advanced for the effect of steam in bringing on symptoms. Moore found that the drug was absorbed much more rapidly by oily hands. At any rate, there is a very general and very healthy belief among the men that "T.N.T. and whiskey don't mix."

Practically all observers agree that more cases of poisoning occur in warm weather than in cold, as Rice's (11) interesting tables illustrate well. We did not have a chance to verify this for ourselves, as the weather was temperate during our entire stay at the plant; but from the histories, the skin eruptions had been more severe in the height of summer.

We could not make out any racial idiosyncrasies to trinitrotoluene, although we had opportunity to observe whites, negroes, Haitians, Cubans, and Porto Ricans. No women were employed in these trinitrotoluene works.

CONCLUSIONS

1. The symptoms of mild trinitrotoluene poisoning may be grouped as follows, approximately in order of their usual appearance:
   - (a) Those apparently due to gastro-intestinal irritation — distress, diarrhea, loss of appetite, nausea, vomiting.
   - (b) That due to cutaneous irritation —dermatitis.
   - (c) Those due to alteration of the blood—dyspnea on exertion, dizziness, headache, fatigue, pains in the legs, sleepiness.
   - (d) Those due to renal irritation—urgency and frequency of micturition, lumbar pain.
   - (e) Those due to degeneration of the liver—pain and tenderness in the right epigastrium.

Many of the above symptoms may doubtless be produced in more than one way; thus, fatigue may be due to general intoxication, and gastric symptoms may be secondary to degeneration of the liver.

2. A palpable, tender liver is necessarily an ominous symptom.

3. The characteristic discoloration of skin, and the cyanosis, give a general indication of the extent of absorption.

4. The Webster test is practically specific for the presence of altered trinitrotoluene in the urine, and is a useful measure of the extent of absorption; otherwise, it appears to have little prognostic value.

5. The altered trinitrotoluene is excreted in combination with some body (probably glycuronic acid) which reduces Benedict's solution but is not fermented by yeast.

6. No acidosis could be demonstrated by Sellard's test.

7. No "nitrite effect" upon blood pressure was found.

8. The skin is the chief avenue of absorption and preventive measures should be aimed largely at avoiding contact with the material.

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SYPHILIS, AN INESTIMABLE FACTOR IN INDUSTRIAL INEFFICIENCY *

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THAT syphilis is a moral corrosive has been commonly understood, that it has been a menace to personal and public health is a matter of common knowledge; but that it could be regarded as a prolific source of industrial inefficiency has just dawned upon the profession. Too little attention has been given in the past to this disease by the industrial physician and the profession as a whole. Surely it is high time that active measures be taken against an enemy that fills our insane asylums, causes thousands of stillbirths, stands as a large factor in all of the killing diseases, and causes a sufficient decrease in the efficiency of the working world to rank it as one of the most important economic problems in industry.

There are several possible reasons for our past inaction. First, syphilis has always been associated with immoral sexual relations, and little attention has been given it as a public menace. Second, we have very little knowledge of the prevalence and extent of the disease. Third, through a false sense of modesty, it cannot be given the publicity it deserves.

Difficult as it is to gather data, these few statistics will serve to emphasize the immensity of the problem with which industrial physicians are confronted. The city of New York has for the past few years made venereal diseases reportable. In the fourteen weeks from July 4 to October 3, 1914, 25,633 infectious diseases were reported. Syphilis stood first, with 6432 cases, or 28 per cent.; Tuberculosis second, with 5525 cases, or 21 per cent.; Diphtheria third; Measles fourth; and Scarlet Fever fifth. This report, however, shows only those cases that were reported, probably 50 per cent. It is inconceivable then that a disease of such extent is not a cause of industrial inefficiency. In the army during the fifty-three weeks ending September 27, 1918, there were reported 178,204 venereal diseases. About 16 per cent. or 27,000 of these were syphilitic. During 1917, 750,000 days were lost to the army through venereal disease, but in the year 1918 the loss reached the alarming total of 2,067,000 days. The fact that has been both encouraging and surprising from the army point of view is that 85 per cent. of the soldiers so afflicted were already infected when they entered the service.

Colonel Vedder in his recent book *Syphilis and Public Health* says that 20 per cent. of the young adult population from which the army is recruited, in peace time are luetic, and he estimates that 5 per cent. of our young men in college are infected. He says "Since syphilitic infection is so common and so productive of disability, and has so far evaded sanitary control, it is believed that syphilis is a greater menace to the public health than any other single infectious disease, not even excepting tuberculosis." Osler has recently said that of the killing diseases, syphilis ranks third or fourth. He estimates the actual annual deaths at 60,000, which makes it rank first among the infections. Leredde estimates that syphilis kills 25,000 each year in France.

Some careful investigations have been made on the incidence of syphilis among the tuberculous of the country, and it has been estimated that between 20 per cent. and 30 per cent. of those so afflicted also suffer from lues. It has been shown many times to be an important predisposing factor in tuberculosis. In the last few years at a number of the general hospitals in larger cities, Wassermann tests have been made a routine part of the examination. From a study of figures estimated in this way, it is fair to state that between 20 and 30 per cent. of the patients in the average hospital are infected with syphilis. In view of these figures, can we say that syphilis is on the decrease?

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The campaign against this disease directly concerns industrial physicians. Syphilis is a powerful factor in industrial inefficiency. While the acute primary and secondary lesions are a possible source of infection to hundreds of innocent employees, it is the chronic tertiary untreated or insufficiently treated cases that work havoc in industry. They are the potential causes of accidents to themselves and to others. When injured, their disability is always prolonged. They are generally chronic absentees—inefficient employees—and a source of trouble at all times.

The following case records clearly demonstrate the necessity of ferreting out all old luetic cases and placing them under proper treatment.

Case 1.—Sam W., aged 42, Norwegian by birth, was one of our most constant visitors at the hospital. He was of a sullen, morose disposition, and there was constant friction between him and his foreman. Previous to his employment in this industry he had been a sailor, and during that life had suffered a fractured spine by falling from a mast. After working for us a short while a box accidentally fell from a loft, injuring his back. He was taken to the hospital and a careful examination made, which disclosed nothing but his old fracture. He recovered and returned to work, and was a fairly satisfactory employee for several years. Then he began to be a visitor at the hospital. He was certain the injury to his back was responsible for the pains in his back and legs. He was given a thorough physical examination and it was found that his knee jerks were sluggish, a Romberg sign was present, and his pupils failed to react. A Wassermann was done on his blood and spinal fluid, and both found positive. He was immediately transferred to our clinic and energetic treatment begun. While his tabes is not cured, Sam is a much improved man. He takes his treatment conscientiously, his back and leg pains have disappeared and his efficiency has improved 60 per cent.

Case 2.—B. R., aged 44, a foreman in one of the busiest departments, became so inefficient in his work as to attract the attention of his manager and his fellow employees as well. From a bright, active, energetic foreman, he had suddenly changed to an absent-minded and careless workman. Important orders were forgotten, and worry over his condition was evidently making things worse.

Knowing that something was wrong, his manager sent him to the doctor's office for a complete examination. Several months previously, while on his vacation, standing on his front porch one evening, without any warning he fell over, became unconscious, and remained so for a short time. When he recovered consciousness, he knew nothing of what had happened. After a few days' rest in bed he recovered and returned to work. The incident bothered him a little, but not to the extent it was destined to when he had several more similar attacks. His family physician pronounced it "nervous exhaustion", but he did not improve under treatment. He hesitated about consulting the company physician for fear of losing his job—a fear that had no basis. He was thoroughly examined, a Wassermann was done as a routine measure and proved to be very positive. His spinal fluid was then tested and also proved to be positive. He was told of his condition and then admitted having had an initial lesion twenty years previously, for which he had taken little or no treatment. Anti-syphilitic treatment was begun at once, and has been continued ever since. His health is very much improved, he has had no more attacks and his work has returned to better than its previous standard.

Case 3.—B. C. (female), aged 18, was a thin, poorly nourished girl. While working in the millinery department trimming hats, she scratched the back of her hand with a piece of wire. She thought nothing of it, and did not report to the doctor's office. A few days later she developed a lymphangitis of the hand and forearm. She was taken to the hospital and the condition rapidly subsided under hot dressings. She was sent home, and a few days later had a recurrence of her trouble. It again subsided under proper treatment, but did not remain so long. After about three weeks of this disappearance and reappearance, a Wassermann was made. It proved to be very positive. The girl showed other unmistakable signs of congenital syphilis. Anti-luetic treatment was begun at once and she began to improve. The treatment helped a great deal, but this girl was at and away from work for two years before she became well enough to be an efficient employee. This was a case of congenital syphilis complicating a very simple infection. Practically two years of employment were lost, a rather expensive case for the industry.

Case 4.—H. G. (female), aged 20. A helper in the restaurant was sent to the doctor's office by her manager because of a suspicious cold sore on her lip. Examination showed the sore to be simply teeming with spirochetes. Careful inquiry into her history disclosed the fact that she had been married two months previously. I explained to her the necessity of talking things over with her husband. He consulted me at my office, and I found his mouth and throat full of mucous patches. He had had the infection for a year, but had taken no treatment because he could not afford it. The girl was laid off and she and her husband were transferred to our industrial clinic for treatment. Ignorant as this girl was of the nature of her infection, she was a possible source of trouble to hundreds of innocent fellow employees.

These and countless other cases I could enumerate ought to be enough to make the industrial physician realize that this nation-wide campaign against the venereal diseases is his fight. The program here outlined for industrial physi-

cians to follow is, in many features, similar to that carried out by the army in the war. Under this program the annual venereal disease rate in the army has dropped from 83.6 per 1000 in 1915 to 20 per 1000 in 1918.

The program embraces four parts:

1. Educational and social measures similar to those carried out by the Commission on Training Camp Activities. This should include talks, lectures, and the distribution of pamphlets concerning the disease; personal talks to the girls by a woman physician, the chief nurse, or a well-informed social worker, and talks to the men by the chief surgeon. These talks, if they are of the right kind, are of a great deal of value. Exhibits of posters, lantern slides, and moving pictures can all be used to advantage. The film *Fit to Fight* can be borrowed from the Public Health Service at any time. Anything that diminishes sexual desires should be encouraged. Baseball teams, track athletics, basketball, and bowling teams should be organized. These measures have been of immense value to the army. They should also benefit our civil population.

2. Prophylaxis after exposure. It is unreasonable to expect and decidedly impracticable for industries to maintain prophylactic stations. They will, in the near future, be installed in every industrial community by the Public Health Service. It is our duty to teach men that once they are exposed, prophylaxis does protect in the great majority of cases, if taken immediately after, or within six hours of exposure—the quicker the better. This treatment includes scrubbing well with soap and water, washing with a mercuric chloride solution, dilution 1:2000, a thorough rubbing with 33 per cent. calomel ointment, and an injection of 2 per cent. protargol to prevent gonorrheal infection. In the army, of 23,702 men taking prophylaxis over a period of twenty-two weeks only 1 per cent. developed a venereal disease, although many did not apply for many hours after exposure.

3. Medical examination of employees. By a careful examination of all male and female applicants for work, and the supervision of the health of the old working force at every opportunity, many cases of syphilis will be discovered. Male applicants can be stripped and a careful examination including Wassermann test done on all suspicious cases. Females, of course, cannot be examined as thoroughly, but a careful inspection of the mucous membranes and skin can be made, Wassermann done, and, if the industry has a female physician, vaginal examination made when it seems necessary.

The outfit for careful examinations of initial lesions can be installed in any laboratory at a cost of not to exceed $25. This sum will buy a dark field illuminator and a good carbon light, which are all the equipment required in addition to a microscope. The technique for examination of spirochetes is easily mastered and this examination should be made of all lesions that bear any resemblance to lues. The day of waiting for secondaries to appear before administering treatment is past. Suspicious cold sores of several weeks' duration should always be examined, especially if there is accompanying glandular enlargement. In two years' time twelve lip chancres in girl employees in one industry were discovered.

The officials in industry must be taught and encouraged to adopt a broader policy than has heretofore been followed. Too often in the past employees have been dropped from the pay roll the moment they showed signs of venereal trouble. This tends to discourage physician and patient. Employees, exposed and afraid to report to the reputable physician in charge of their health, evade him and consult the advertising quack. They are bled financially, poorly treated, if treated at all, and then left when their money gives out to go untreated, worrying over their expended money and the fear of the disease. This one factor alone is a cause of inefficiency.

The industrial physician in his daily work comes in contact with such a large number of people that if he is at all the right kind of man he is in a position to do untold good to a large number of them. He must have the confidence of the employees, but once he has that it will be surprising to him the number of latent and chronic cases of syphilis he can unearth.

4. The Treatment of Syphilis. When once discovered, what should be done with the disease? J. H. Blaisdell of Boston selected sixty cases that came to him

in the infirmary and found that between the time of their infection and the time of their first appearance for treatment these cases had exposed 134 other individuals by coitus, 442 through family life, 651 by occupational association—in all 1227 people. At least sixty new cases developed and only two were brought under treatment. This points out our course. In addition to instituting thorough treatment in those we find with syphilis, run down the sources of their infection and aim to get these individuals under treatment. Discover the contacts of our case if possible and examine them thoroughly. The industrial physician has the opportunity offered few others of doing efficient and valuable public health service.

What should constitute thorough treatment? We have at Rush Medical College in Chicago a large clinic for the treatment of syphilis. Here we have tried to treat syphilis as efficiently as our modern methods will permit. Arsphenamine intravenously and mercury intramuscularly are our weapons. The course of treatment consists of six injections of arsphenamine at five day intervals. Between each injection of arsphenamine, one or two injections of mercury are given intramuscularly. After completing the six arsphenamine injections about fifteen or twenty injections of mercury are given three times a week, or at five day intervals, depending upon the salt of mercury used. This constitutes one course of treatment. The patient, after completing this, rests six weeks, and then a Wassermann is done. If the findings are still positive the course is given again. If negative, he rests for three months before another blood test is made. If positive then, another course is given. If at the end of two years his blood and spinal fluid are found negative, and, by repeated examinations, he has shown no sign of lues, he is discharged as cured. It should be impressed upon the patient time and again that he is not to discontinue treatment until he is told to do so by his physician.

It has been found from experience that very few patients will refuse treatment once they have their condition carefully explained to them. A good confidential talk will convince even the most ignorant and skeptical of the necessity of taking thorough treatment. Sometimes patients become a little careless about reporting after their sufferings have been alleviated, but through our social workers we keep in touch with them, and constantly remind them of their duty to their families and to themselves.

The cost of treatment is the thing that keeps most patients from taking care of themselves. With the cost of living exorbitant as it is, the average man with a family and a monthly wage of $150 or less, has a hard enough time paying for the bare necessities of life, without thinking of incurring doctors' bills for a disease that is not bothering him appreciably. Pay clinics are the solution for this problem. Clinics which will permit people of the middle class to obtain expert medical care for a small sum.

If we are to eradicate syphilis, and that is the question of the hour, we must, by all means, treat the existing cases of it first. These are our source of infection. In Chicago, we have been fortunate in having a large venereal clinic in connection with our industrial medical and surgical clinic. There all cases referred from the various industries are treated free of charge, or at a very small cost. Other industries will not be so fortunate in being located near a clinic. In the very near future, however, they may be aided by the Public Health Service. The number of clinics being operated solely by the Public Health Service now is twenty-six, in co-operation with state boards of health, 134. The number of clinics is being rapidly increased and it is believed that within a short time no industrial community will be without one. If an industry is not located so that recourse can be had to one of these, the staff can readily establish one where arsphenamine and mercury can be given at a very slight cost to those employees who, through financial reasons, are unable to consult specialists. Eliminate the financial question and all infected employees will only be too glad to take care of themselves. Once this is done efficiency is bound to increase.

Industrial physicians, the public health servants of their own communities, should encourage the building of hospitals for the treatment of venereal diseases. The number of hospitals equipped for and willing to treat acute syphilis is very small even in our large cities. The army

method of treating acute gonorrhea and syphilis at the base hospital, by keeping the patient in bed, and in a way quarantined, is a rational method of treating these diseases. It is only by keeping the acute cases under constant surveillance and from association with the world at large that we can hope to eradicate successfully the source of infection. For that reason, industrial physicians must work for the establishment of hospital wards in all hospitals, for this treatment. This will mean a big step in helping to eradicate the disease.

By following out some such scheme as has been indicated in this article, industrial physicians can play a large and important part in this campaign against syphilis, an inestimable factor in industrial inefficiency.

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INDUSTRIAL MEDICINE AND SURGERY—A RÉSUMÉ OF ITS DEVELOPMENT, SCOPE AND BENEFITS *

PART II

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THE United States is now entering the period of reconstruction following the great World War. Vast changes in the economic and industrial forces of the country are bound to occur. This nation, which entered the world conflict in order to make the world safe for democracy, will demand a truer, more just democracy at home. Misuse of political and economic power will not be tolerated, but all things which tend to give peace, comfort and contentment to our people—a true social democracy—will be exceedingly welcome.

The present labor unrest in Europe has already caused a reflex in this country, enhancing to a degree the unrest which was more or less prevalent. Both capital and labor recognize that the cure for this undercurrent of dissatisfaction is the reestablishment of a closer relationship, a better understanding, between the employer and those employed.

The cure for Bolshevism is a true democracy for all. Such a democracy can only exist when all our people have proper living conditions; a working day which allows sufficient time for the recuperation of the bodily forces, instead of the long hours of labor with no time for pleasure and relaxation; opportunity for education and development for the children, instead of the nation's shame—child labor; protection from exploitation of the women who must work; in fact, a spirit of justice and unselfishness among the employers, which will engender a spirit of loyalty and contentment among the employees.

The signs of the time indicate that during this period of reconstruction industry will solve many of these problems, and that both the employer and the employed will join hands in a mutual interest, with a better understanding than has ever existed before. Many forces are at work in industry to accomplish this end. One need only read the programs during the last three years of four national associations—the Employment Managers' Association, the National Industrial Engineers' Association, the National Safety Council, and the American Association of Industrial Physicians and Surgeons—to observe these signs. The members of these associations and of similar organizations, employed in hundreds of the great industrial concerns throughout the land, represent the leaven constantly at work to make possible the ideals of a true social democracy.

The very foundation of all these efforts is *better health*, the protection from occupational diseases and from accidents—*the conservation of the nation's man-power.*

Industrial medicine and surgery embody all phases of this human maintenance service, and are intimately connected with all other branches of employees' relations. The industrial physician who neglects the questions of hours of labor and of wages, the relationship between managers and foremen and the men and women under them, the living and home conditions of the employees, the food, the recreation and the general environment of each individual on the working force, will not attain the full purpose of a medical service in industry.

To reiterate†, the scope of Industrial Medicine includes:

A. Plant sanitation.
B. Prevention of occupational diseases.
C. Prevention of accidents.
D. Health supervision of employees, by:
    1. Physical examination.
    2. Examination of applicants.
    3. Educational propaganda.
    4. Protection against contagious diseases.
E. Surgical care of all injured.
F. Supervision of medical treatment, or, as is

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†See Industrial Medicine and Surgery, Part I, The Journal of Industrial Hygiene, 1919, 1, 1.

done in a few concerns, rendering complete medical care.

G. Complete care in certain diseases, as tuberculosis, syphilis.
H. Visiting nurses' service to sick employees.
I. Improvement of home conditions.
J. Improvement of community conditions.
K. Co-ordination and co-operation with all forms of welfare service in industry.

No system of industrial medicine is comprehensive that does not include the ramifications of the above general phases in its scope.

To-day, with the profession on familiar terms with industrial medicine; with at least six medical schools teaching some phase of the work; with state and federal legislation embodying its principles, it can truthfully be affirmed that this new specialty in our profession—Industrial Medicine and Surgery—has arrived and is now firmly planted in the economic structure of the nation.

This résumé of the new development and the scope of industrial medicine leads us to this important consideration: Does it pay? From an economic viewpoint, what is its value to industry?

One of the greatest sources of saving to the employer is the physical selection of employees for work. *This is done by the physical examination of all applicants for work before employment.* The value to the employer depends upon the thoroughness of these examinations and the amount of co-operation between the employment department, the medical department and the foreman.

The old system in vogue before medical examinations of employees was introduced into industry, and which still exists in so many places, resulted in wasteful occurrences such as the following:

1. A man applied to the employment department or to the foreman for a job. He had had words with his foreman in another industry and had left. (This was the result of less and less work due to a physical handicap of which he was not aware.) Experience made him valuable for certain types of work. He was employed and thrown into the human machinery of this new industry without any investigation as to his physical fitness. His work was on a machine and was very heavy. He exerted himself to make good and at first succeeded, but gradually the production of his machine fell behind, and after two months the foreman was forced to let this man go. For two months an expensive machine had failed to produce sufficiently to pay for its maintenance—a definite loss for the employer. And why? Because this man who was employed blindly had a beginning locomotor ataxia and was physically unable to make good. An examination when he applied would have prevented his employment, saved the loss from inefficient operation of the machine, and the cost of hiring and firing a man.

2. A laborer was employed by an electrical company. Their medical staff did not include medical examination of applicants as a part of their work. Therefore, without ascertaining his fitness, this laborer was assigned to help repair boilers. Two weeks after employment, while working in a boiler, he dropped dead. A nearby electric light was broken when he fell. A shyster lawyer persuaded his family that the man's death was due to an electrical shock, and suit was entered against the company. The autopsy immediately after the man's death showed an old chronic heart lesion, and death was recorded as due to acute dilatation of the heart. There was no sign of an electrical burn. When the case appeared before the Industrial Commission the family was awarded $3,500. Naturally the company carried the case to court, and after a long fight they were absolved of all responsibility for the man's death. The expense of employing expert witnesses, legal talent, etc., was very heavy. This blind hiring of a defective human machine cost this company over $5,000 for two weeks of service.

The placing of all comers on jobs without any effort at a physical selection for their work is responsible for a great financial waste which cannot be shown in dollars and cents, but which, nevertheless, is very evident. Some of the sources of waste from the employment of the physically unfit are the following:

A. The unfit who later must be discharged because of inability to do the work.

B. The unfit who may continue to work for a few months or a year, but with a gradual decrease in their efficiency, due to advancing disease. Sooner or later they are forced to stop work, and during the entire period of employment they have been a source of loss to the company employing them.

C. Those who because of their physical condition are subject to frequent accidents.

D. Those who suffer accidents which ordinarily would not be serious, but, because of coincidental physical conditions, cause prolonged disability or even death.

E. Those having some contagious disease when employed, who communicate it to others in the working force. The acute contagious diseases are more common, but tuberculosis and syphilis also cause a great loss.

F. Employment of the mentally deficient, the moral degenerate, and other types of mentally handicapped men who make up a certain percentage of the floating labor. An observing industrial physi-

cian will pick out this type during the course of his examination.

Companies which have an efficient medical system always include the examination of applicants as a definite part of the work. These examinations are not made for the purpose of selecting only the physically fit and refusing employment to all others, but are made for the following purposes:

(a) To prevent persons with diseased conditions which make work of any kind dangerous to them, from going to work; (b) to select for persons with certain defects proper jobs where they can still be efficient and yet the work will not be hazardous to them; (c) to prevent persons with contagious diseases from mingling with the old working force.

The writer has collected statistics from ten large industries, having very excellent medical staffs, which examine all applicants for work. Their rejections are based, for the most part, on the above standards. The following table shows the results of these examinations:

1. Total number of applicants examined in one year 118,900
2. Total number employed having disabilities that did not interfere with selected work .... 41,158 or 34.7 per cent.
3. Total number rejected for work because of disabilities .... 11,433 or 9.7 per cent.
4. Total number having no disabilities of any moment .... 66,309 or 55.6 per cent.
5. Total number of regular employees in these ten industries 102,400

It is fair to assume that these 11,433 applicants who were rejected for work would have soon lost their positions because of inefficiency, or would have left because of sickness. Certainly by the end of a year practically all of these would have been eliminated from the working force. It is impossible to estimate accurately what the loss to these companies would have been during that year from having these men and women in their employ. It would have been considerable, however, from decreasing efficiency due to disease, from an increased accident rate, from loss of time due to sickness and the resulting sick benefits in many cases.

Several estimates have been made of the cost of labor turnover. These are based on the cost of employing a man, teaching him a job, and the time elapsing before he becomes efficient or productive. These estimates vary from \$10 to \$200. One authority, after a careful study of this problem in many industries, gives as a low average the amount of \$35 as representing the cost of hiring and training an individual. Therefore, the 11,433 rejected cases in the above table can be estimated as saving the companies rejecting them \$400,155 in labor turnover. A committee of representative authorities on this subject more recently estimated the cost of hiring and training a man at \$45, which would add over \$100,000 additional profit as a result of the practice of medical examination of applicants for employment.

Magnus Alexander in a comprehensive study of the cost of health supervision in ninety-nine different industries found that the average cost per employee for all medical work was \$2.50. Using this figure as a fair average, and taking the regular number of employees as 102,400, we can estimate the cost of the entire medical work in these ten industries at \$256,000. Thus the examination of applicants alone undoubtedly saved these companies over \$140,000 during the course of one year.

1. Saving to ten concerns from rejection of physically unfit \$400,155
2. Cost of entire medical work in these concerns 256,000
3. Profit to the concerns from this one branch of medical work alone.......\$144,155

It is fair and conservative to estimate that at least 10 per cent. of those applicants with physical disabilities who were employed would have left very shortly if they had not been placed on jobs suitable for their physical condition, thus adding to their efficiency, contentment and health protection. This adds another \$144,000 to the profit of the employers from this system.

While the above figures can only be estimated, yet the most skeptical must surely agree that the examination of applicants for work, and the rejection of the physically unfit, even when based on the most humane standards for rejection, certainly pays any concern adopting this system. And the saving to that concern from this procedure alone will more than pay the costs of the most efficient human maintenance department they can establish.

Epidemiology—prevention of the spread

of contagious and infectious diseases among the employees—has added tens of thousands of dollars to the net annual proceeds of the employer. The discovery of tuberculosis during the early stages of the disease and the elimination of employees suffering from it from the working force, has prevented other employees working in close contact with infected individuals from becoming infected. Fortunately most of the concerns practicing this form of protection likewise provide for the care of the afflicted employee, usually sending him to a sanitorium until the disease is arrested. In one industry, during a period of three years, twelve individuals with lip chancres were discovered during the examination of applicants. The menace of these cases thrown into the old working force is quite apparent, as is also the value to the employer in preventing the spread of this disease among the workmen.

In one large industry employing 15,000 people, in Chicago, forty-four contagious cases, representing six different types of the acute exanthemata, were discovered during a period of six months by the system of health supervision in operation in that plant. The early discovery of these diseases, and the constant watchfulness to prevent their becoming epidemic among the employees who were working in close contact, undoubtedly prevented a great loss to this concern from at least six different epidemics. This experience is a fair example of the extent of epidemiology in industry.

The managers of several industries have reported that the careful medical supervision and prompt attention given their employees by their medical staffs during the recent influenza epidemic resulted in a lower sick rate and a much lower death rate among their employees than among their subsidiary industries, where medical services were not maintained.

It is impossible to estimate in dollars and cents the benefits to both employers and to employees that have accrued from the prevention of accidents. Hundreds of industries, however, throughout the country are enthusiastic in their praise of this form of prevention. The prompt care of injury cases by competent industrial surgeons has reduced the period of lost time, the extent of deformities, the number of permanent disabilities, and many deaths. In large concerns where the accident rate is high, in spite of their preventive methods, the profits accruing from prompt, efficient surgical care are known to be far in excess of the cost of the entire medical service. The prevention of infections due to minor injuries in one concern caused a reduction of 70 per cent. in time loss after these preventive methods were installed.

Innumerable examples could be given of the benefits to both employer and employee resulting from the various branches of their industrial medical and surgical services. The ever-increasing number of industries that are adopting this form of medical service for their employees is the most conclusive evidence of its real value. Big business is not in the habit of adopting any type of welfare service that cannot pay its own way. Some employers, however, will see the human side of this work, while others, of a more calculating disposition, will look for the dollars and cents value before installing this system.

In those industries where pioneer work in industrial medicine and surgery has been done, the results should satisfy either of the above types of employers that such supervision pays dividends and makes a happier, more contented working force. It must be the duty, therefore, of every company surgeon, of every safety engineer, and of every so-called welfare worker, to show that *the benefits to the employer are in direct ratio to the thoroughness and completeness of the plan which he adopts for the conservation of the health of his employees.*

Very few employers, even in industries where various plans of health supervision have been inaugurated, realize the reasons therefor and the full significance of this work. If they would only comprehend the value of conserving the lives and limbs of their employees, a social evolution would occur which would react to the great welfare of both the employer and employee, and would solve more labor disputes in a minute than the old system could solve in a year.

PROTECTIVE GARMENTS IN THE WAR GAS INDUSTRY *

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ONE of the interesting medical demonstrations incident to the war, was the effectiveness of measures protecting operatives in the production and handling of the war gases in this country. So successful were these protective measures, that although hundreds of tons of war gases were being produced by processes entirely new, and in the hands of men quite inexperienced in these particular manufacturing problems, the fatalities attributable to the war gases could be numbered on the fingers of one hand, and the temporary casualties were proportionately small in number. And this, despite the remarkable toxicity of the substances produced, the raw materials used, and the tremendous urge of the emergency, demanding as it did almost any sacrifice in order to increase the rapidity of production.

In view of the lessons which may be drawn from this demonstration it may be of interest to analyze the elements of the situation which made possible this remarkable record.

In the first place, the toxicity of the products was well realized by all concerned in their production. The very fact that these substances were manufactured to produce death, advertised their dangerous character. In most cases the war gases were in effect far more deadly than hydrocyanic acid because of the cumulative character of their physiological effects. Thus while hydrocyanic acid at a certain concentration kills, it may be breathed at lower concentrations without injury. On the other hand phosgene, mustard, chlorpicrin, and other war gases produce a pathological effect at practically all concentrations. However low and temporarily harmless the gas concentration may be, if exposure to it is long enough, serious injury results. This peculiarity of the war gases may be roughly expressed by the equation *Time* $\times$ *Concentration* = *Degree of Injury*. Knowledge of this fact gave special impetus to the development of protective measures, and also led to a degree of co-operation between operatives and inspectors and an appreciation of what was being done for safety that was exceedingly valuable.

In the second place, by the nature of the contracts made, control of the plants, operations, and personnel was on a military or semi-military basis. Effective measures for protection could be enforced. While it is difficult to evaluate this factor, it is certain that this discipline had much to do with reducing the number of casualties. What protective measures were decided on could be rigidly put into practice.

In the third place there was no false economy practiced. Since production was, in most instances, either directly by the government or on a cost-plus basis, it was not necessary to count too closely the financial cost of effective protection. It was assumed that *production* must be facilitated regardless of expense, and effective protection with good morale among the operatives, was absolutely essential to high-speed production.

In addition to these factors, each gas was studied from the point of view of its effect on the operatives, with a thoroughness, which has hardly been equalled in medical history. It is probable that the biological and medical aspects of phosgene, mustard and certain other gases is known in greater detail today than that of malaria, heat burns and other common diseases and injuries that have been observed and treated by medical science for generations. The conclusions and practical recommendations developed by this intensive study of the effect of these gases were immediately put into effect in the factories, regardless of cost or prejudice.

As an offset therefore to the fact that there was no experience in the manufacture of these substances to guide the producer, that there was, to begin with, no medical knowledge of symptoms, pathology, prognosis and prophylaxis, and that the gases themselves are the most effec-

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tively deadly substances ever handled, and that they were being handled by the ton or by the car load—as an offset to all this stood the fact that the degree of protection and the measures thought necessary could be dictated by the results of experimental study, carried on by large groups of trained investigators to a degree perhaps never before approached. The net result was therefore a highly satisfactory one, and protection of the workmen became an accomplished fact.

One small phase of the general program for protection was that afforded by special garments. It is probable that, had the war continued, other types of mechanical protection would have reached such perfection that the garments could have been eliminated entirely, except in certain highly exposed positions. Indeed before operations ceased this was already true of certain plants. Garment protection must therefore be considered as a temporary expedient, to be abandoned more or less completely as automatic machinery and standard practice made its use less necessary.

The need for highly specialized protective garments developed with the demand for the skin irritant gases like "mustard." This group of war gases is characterized by rapid penetration of the skin by either vapor or liquid, in addition to the effect on eyes and respiratory tract. The gas mask gave excellent protection to eyes and lungs, but the skin was injured as quickly through ordinary garments as where it was not covered. The skin lesions were so slow and insidious in their onset, and so slow in their healing, that it was realized how readily the entire personnel of a plant might be temporarily incapacitated by a single accident. To guard against this it became necessary to develop garments which would guarantee protection to a man in an atmosphere which would otherwise produce burns, or to discover some other way of insuring protection to his skin. Thus protective garments and ointments were studied and developed simultaneously, with reference both to the field of battle and to the factory.

The first problem for solution was the selection of the fabric and impregnators to be used. Rubber preparations were unsuitable except in short emergency situations because of the rapid penetration of rubber by "mustard." Rubber serves to hold the mustard as a reservoir near the skin and so may do more harm than good under certain conditions. Heavy rubber gloves and boots were used, but special precautions had to be taken for the demustardization of the rubber before the gloves or boots could be reissued for use. Certain types of the American oilcloth were found to offer fairly effective resistance to penetration by mustard. A very large variety of fabrics were made up and tested against both the liquid and vapor, and for these tests an elaborate procedure was developed in the Research and Medical Divisions of Chemical Warfare Service. Penetration of a fabric was tested both by chemical means and physiological—i. e., determinations were made of the time required for a standard weight of the liquid, applied to a standard area of the cloth, to penetrate sufficiently to cause a chemical indicator to react, or to cause a burn on human skin when the fabric was applied for a standard length of time. The details of these tests are not of general interest, since each type of substance to be tried demands its own particular procedure. The general result was that "slicker" material of good grade, such as could be obtained on the market in quantity, was found to offer considerable protection against mustard vapor, and a short protection against the liquid. Finer types of varnished oilcloths, made up by impregnating very close-woven fabrics, offered considerably more protection. Such cloth, free from pin holes, will keep out the vapor for hours, and the liquid for shorter periods, but long enough so that a man splashed with the liquid, or exposed in his work to high vapor concentrations, may still expect to be able to remove his contaminated garments, and escape unburned from a situation where ordinary clothing would be worse than useless.

Coverall suits were made up from such material and, while clumsy and fatiguing, could be worn by workmen in cool weather. In warm or hot weather such suits rapidly become almost intolerable, and would be discarded by average factory workmen. It was possible to keep men working in these suits in the gas factories by military discipline. These garments

were made up in large quantities and issued at the front and to gas factories.

An early modification of these suits was intended for use in the most dangerous and exposed situations. The coverall suit was combined with a light metal helmet and attached by a hose to an air line, so that fresh air was blown over the face of the wearer, keeping the window clear, ballooning out the suit, and escaping through the seams and about the shoes and gloves. Such a suit was in effect a diving outfit and would enable the wearer to work in almost any concentration of mustard, for any length of time. The air current kept the temperature down, allowing evaporation of the perspiration, and by its outward flow preventing any possible accumulation of gas inside. The use of this type of suit was limited, of course, to those portions of the plant to which compressed air pipes ran, and by the working radius of the air hose. The suits were valuable mainly in giving confidence that, should it be necessary to work in a highly dangerous situation, the operator could be certain of safety.

A modification of this idea was the coverall suit having a hood which could be tightly drawn about a man's face, with the gas mask in place, thus preventing entrance of gas, and insuring air for breathing free from gas. Such a combination offered greater latitude for working but was, of course, hot, and the field of vision was much more restricted, being that allowed by the eyepieces of the regular army mask only.

Neither of these suits had any considerable actual use. It is probable that the air-lined type, because of its greater comfort, more complete protection, and large field of vision, would have remained as a part of the permanent emergency equipment of mustard and similar plants, while the other type would have been discarded.

The garment largely issued for use in the plants was a coverall suit of slicker material. It could be tied at wrists and ankles, and was supplemented with protective shoes, and gloves, and masks when the latter were needed. These garments were removed after factory hours and were demustardized with chloride of lime, water, or by long airing, before reissue. No standard practice for removing mustard had been developed when operations ceased. These garments had a number of bad features. They were clumsy and heavy, excessively hot, and their life was short. Constant creasing or bending produced leaks. They were easily abraded, and any chlorinating method of removing mustard from them produced rapid deterioration. A constant supply of fresh garments was therefore required.

Another type of garment developed was made of open-mesh fabric, like porous underwear material, and was impregnated with substances which would absorb mustard. Such garments allowed transpiration of air and thus the evaporation of perspiration from the skin of the wearer, but would protect against mustard vapor for a limited time but not against liquid mustard. They were more comfortable and less clumsy than the oilcloth suits, but were heavy and disagreeable, at best.

Still another type of garment, which was being perfected when the war ceased, depended on the impregnation of the fabric with a hydrous gel through which the moisture of the skin could pass and evaporate, but which was impervious to mustard gas or liquid for a considerable time. While this garment was never given a factory trial, it promised to be a great improvement over the others. It too was rather heavy and, of course, rather hot. Its wearing qualities were never given an actual test under factory practice.

Garments and gloves were also made containing a layer of thin fabric or paper impregnated with a gum-glycerine gel and protected by layers of cloth on either side. This material actually stood up against liquid mustard for days without penetration, but it was very heavy, hot, and clumsy. It could have served as an impervious apron against splashes on the front of a man, but it was not suitable for a complete coverall garment.

One of the most difficult problems was the protection of the workmen's hands. The danger of vapor or splash burns on face or body was quickly reduced to the minimum in operating plants, but there was constant danger to the hands. Gloves of oilcloth as well as ordinary cotton gloves dipped in linseed impregnating mixtures, were tried. Such gloves were

quickly worn or creased to the point of being more a menace than a protection. Heavy rubber gloves were fairly good but allowed mustard to accumulate, dissolved in the rubber itself, and led to burns inside. The best gloves appeared to be those prepared by impregnating good-grade "splits" leather gloves such as were issued by the Quartermaster Department, with a carnauba wax and oil formula. Such gloves were more flexible than the oilcloth, wore far better, and could very easily be degreased and demustardized in gasoline and reimpregnated, if contact with mustard was suspected. The same wax-oil formula was used to impregnate leather shoes for service in mustard plants. Like the garments, the glove and shoe problem was still in the experimental stage when the manufacture of the war gases was discontinued.

From observations made during the manufacturing period of the war, the author is inclined to believe that protective garments, gloves, masks, etc., can be used to great advantage in industries where the production of highly toxic or irritating vapors is unavoidable. Garment protection, however, should be considered only as a temporary measure of protection or as valuable in emergencies or particularly dangerous situations. It is doubtful whether workmen can be expected to undergo the discomforts and fatigue incident to prolonged wearing of such garments as have been described above, or whether they would continue in employments where such garments were prescribed. Much can be done undoubtedly to lighten the weight and increase the comfort of protective garments, provided research is concentrated on the problem. Without great improvement, it is not believed that this solution of the protective problem is largely applicable to peace time industries.

BOOK REVIEWS

The Physiology of Industrial Organization and the Re-employment of the Disabled. By Professor Jules Amar, Director of the Laboratory of Physiological Research in the Conservatoire des Arts et Métiers, Paris, France. Translated by Bernard Miall. Edited with notes and an introduction by Professor A. F. Stanley Kent, M.A., D.Sc., Oxon. Pp. 371, with illustrations. London: The Library Press, Ltd., 26 Portugal St., W. C., 1918. New York: The Macmillan Company.

The English translation of Professor Amar's book reaches the United States at a fortunate time. We are receptive toward efforts at exact measurement of working capacity as we have never been before.

The book represents a determined and often very ingenious effort to apply well-known physiological methods for the measurement of work in the simpler animal preparations of the laboratory to working conditions in human beings.

There is an opening chapter dealing with the history of efforts at exact physical evaluation of labor and ending in a brief discussion of the Taylor system of scientific management, of which the just physiological criticism is offered that "like La Hire, Amantons, and Coulomb, Taylor considered only a part of the human machine—that which performs work." He neglects the physiological limitations of this machine and so, without modification, his system cannot spell success. It would seem that no system could be more foreign to the French genius than that of Taylor, which must inevitably tend to subordinate the individuality of the worker to the exact dictates of mathematical direction. One feels, perhaps, that Professor Amar as well as Professor Kent in his introduction is under a false impression as to the extent to which what may be called literal Taylorism exists at the present time in the United States. Foreign writers would do well to recognize the scientific management developed by Taylor as a decided influence in American industrial organization but not as a successful rule of conduct for the entire country.

Professor Amar introduces his own work in industrial physiology by a chapter on the Organic Functions of Man, and follows this with another on Human Psycho-Physiology. It is rather noteworthy that the contributions upon which this applied physiology is apparently based are practically entirely French and German. It is hardly possible to treat the physiology of the nervous system without rather thorough dependence on English contributions to the subject.

Under Work and Fatigue, the Factors of Labour, and the Art of Labour, Amar presents his real contributions to industrial physiology. Making use of Marey's tambours and a variety of ingenious additional appliances, measurements have been made of such familiar types of work as planing, filing, shoveling, etc. These studies serve as aids for standardizing such processes in terms of the minimum necessary effort for accomplishment of the task in question. Qualitative differences in the curves secured indicate the smooth and regular worker as opposed to the irregular and less efficient beginner. Such curves may eventually find usefulness in checking up the rate of training or condition of efficiency of the apprentice.

Final chapters in the book deal with Re-Education of War Cripples. Here again Professor Amar makes effort at exact physical analysis of the tasks to be fulfilled, and attempts to create artificial limbs in accordance with the true mechanical requirements of the case in question. As in the earlier chapters of the book, both the final artificial appliances evolved and the methods used in measuring their efficiency are thoroughly illustrated and give one a working idea of the efforts Professor Amar has made.

The book is a pioneer in a field which will have much attention during the next decade. It pictures a courageous attempt to measure the almost immeasurable and deserves the thorough consideration of all those interested in the most modern efforts at evaluation of labor.—*Cecil K. Drinker.*

The Science of Labour and Its Organization. By Josepha Ioteyko, formerly head of the Laboratory of Psycho-Physiology at Brussels University, Laureate of the Institute and of the Academy of Medicine, in charge of the course on "Fatigue" at the Collège de France in 1916. Pp. 199, with illustrations. London: George Routledge & Sons, Ltd.; New York: E. P. Dutton & Company, 1919.

This small volume presents a series of articles written during the years 1916 and 1917. The reader will find difficulty in following any consistent theme through the whole presentation and should accept the book as a set of essays relating more or less directly to industrial problems.

The first two chapters on The Human Motor and The Principles of Scientific Management are quite useful summaries in the first instance of organized continental effort for study of industrial fatigue, and in the second of scientific management. This latter chapter defines the physiological limitations of Taylor's system in a thoroughly useful manner. The third chapter, on the Power and Aptitude for Work, concerns itself chiefly with the author's views on right-handedness and the advantages of bi-manualism. It is rather hard to conceive that the benefits of ambidexterity can be of so wide importance as Ioteyko represents. The book closes with an account of the Belgian methods of education for industry, and is, on the whole, a useful reprint of material not readily available for English and American readers.—*Cecil K. Drinker.*

NINTH CONFERENCE OF INDUSTRIAL PHYSICIANS AND SURGEONS

The ninth conference of industrial physicians and surgeons will be held at the Hall of the House of Representatives, Harrisburg, Pa., on Monday, Sept. 22, 1919, under the direction of the Division of Industrial Hygiene and Engineering of the Bureau of Inspection of the Department of Labor and Industry, of Pennsylvania. For particulars, address Dr. Francis D. Patterson, Chief, Division of Industrial Hygiene, Department of Labor and Industry, Harrisburg, Pa.

SIXTH ANNUAL MEETING OF THE INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONS

The sixth annual meeting of the International Association of Industrial Accident Boards and Commissions will be held in Toronto, Canada, Sept. 23-26, 1919. For particulars, address the Secretary-Treasurer, Royal Meeker, Commissioner of Labor Statistics, Washington, D.C.

EIGHTH ANNUAL SAFETY CONGRESS

The eighth annual Safety Congress will be held at Cleveland, Ohio, October 1-4, 1919. For particulars, address the Secretary of the National Safety Council, 168 North Michigan Avenue, Chicago, Ill.

AMERICAN PUBLIC HEALTH ASSOCIATION TO MEET IN NEW ORLEANS

The next annual meeting of the American Public Health Association is to be held at New Orleans, La., October 27-30 inclusive. The central themes of discussion will be Southern health problems, including malaria, typhoid fever, hookworm, soil pollution and the privy, etc.

The general belief among the health profession is that influenza will return next winter, and a full session will therefore be devoted to this subject for the purpose of developing methods of control.

A special effort has been made to arrange the program to meet the practical needs of health officials. Accordingly there will be discussion on such questions as the attitude of legislators toward public health, the obtaining of appropriations, co-operation from women's clubs, health organizations, etc., the organization of health centers, and so on.

The programs of the sections will, as usual, deal with public health administration, vital statistics, sanitary engineering, laboratory methods, industrial hygiene, sociology and food and drugs.

Two special programs will also be presented on various phases of child hygiene and personal hygiene.

Winter railroad rates to New Orleans will be in effect from all points after October 1.

The program of the meetings will be published in the American Journal of Public Health appearing October 5 or may at that time be had upon application to the Secretary, 169 Massachusetts Avenue, Boston, Mass.

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WAGE-EARNING WOMEN IN WAR TIME: THE TEXTILE INDUSTRY*

(With special reference in Pennsylvania and New Jersey to woolen and worsted yarn, and in Rhode Island to the work of women at night.)

FLORENCE KELLEY
General Secretary of the National Consumers' League

AMERICA'S participation in the war was reaching its height when the gathering of the material used in this article was begun in June, 1918. The demand for war supplies was approaching its maximum. The rapidly increasing employment of women and girls in producing them was a matter of grave concern to the Secretary of War as the largest indirect employer in the United States. The National Consumers' League of which he has for several years been the President undertook, therefore, a quick survey of women's work.* The complete results will be published under the title, *Wage-Earning Women in War Time*, and will appear as a United States Senate document.

No attempt was made to investigate output, profits, personnel, or labor turnover. No questionnaire was sent to employers. Information was gathered through field investigation and personal interviews with manufacturers and workers. In the myriad of formal or technical inquiries, this informal one was intended to shed a little light upon two questions: What is war-time industry doing to women and girls? What can the community do about it?

This study deals only with persons actively engaged in the year 1918. Inevitably they are survivors; and we are without light on the prevalence of health, disease or death among people who, having been employees in the textiles, are there no longer. No one can guess how far the men, women and children who are gone carried away actual disabilities known at the time, or the germs of future bad health acquired by reason of overwork, speeding, bad air, excessive heat, bad light, continuous standing, or any other of the preventable strains characteristic of their work in the mills.

It cannot be too much emphasized that a quick survey, however painstaking, of employees in any industry presents a misleadingly favorable picture of the health of the whole shifting mass of wage-earners connected with that industry. The permanent influence of their work upon *all* the employees can be known only when universal continuous health insurance records become available, and compensation for industrial disease is well established. There are no trustworthy figures covering the continuing mortality or morbidity rates of the mass of workers in the industries or in any one of them, in any city or state.

In a period when maximum production was indispensable for winning the war, the people of this country naturally assumed that employers were making every possible effort to conserve the health, energy and goodwill of the workers. Yet in the textile industry, a great majority of the employers whose places were examined, both those who resorted to night-work, and those who worked only by day, failed to supply the

*Acknowledgment of their participation in the work necessary is made to Pauline Goldmark, A. Estelle Lauder, Alice W. Hunt, Jessie R. Whitnall, Caroline A. Whipple, Agnes deLima, Mary McConnell, Ethel Hanks, and Mary Caplan. Received for publication July 26, 1919.

most elementary means of economizing health, energy and zeal for work.

I

The present chapter was originally confined to the making of woolen and worsted yarn for army cloth and blankets, an industry fed in varying degrees as appears later, by the less conspicuous rag and shoddy industries. In Pennsylvania and New Jersey, eighty-two textile mills,* fifty-nine rag shops and five dealers in waste were visited. The New Jersey establishments included only nine mills, of which, however, one was the largest studied. The mills were selected at random from the Textile Directory and other sources.

By shoddy is meant wool reworked from material already used, traceable both to clippings from factories and to the heterogeneous collections of the rag-man. Incidental to the search for shoddy, a number of waste mills were visited. These manufacture a product from old cotton, wool or silk stock for wiping-waste for machinery, packing for the wheels of locomotives, stuffing for upholstery, for candle wicking, and during the war, as a basis for smokeless powder and for air bombs. Some waste plants manufacture shoddy, and the waste industry proved to be so interlocked with the main subject of the inquiry that it also was included.

On August 16, 1918, a newspaper advertisement of a leading clothing firm quoted General March as saying, "We are going to put the whole civilian population on shoddy for next year." The advertisement continued:

> "Every 24 hours brings us closer to the day when we may have to sell cloths of adulterated wool. . . . not because we believe that shoddy fabrics are as good as all-wool goods; they are not—they can't be—but because we believe in backing up the government in this—and every other exigency."

On July 19, 1918, the War Service Committee of the Woolen Industry had given warning that the wool stock of the country was falling to a figure dangerously low. Through the War Industries Board and the Shipping Board, this committee had before it the needs of the government for woolen cloth and the amount of wool available. The statement ended:

> "In conclusion, the committee ventures to repeat that the conservation of wool and the free use of cotton shoddy and other wool substitutes are the only solution for the present situation and the only course by which 60 per cent. of the industry's weaving capacity for clothing can be operated."

The wool growers meanwhile insisted that there was plenty of wool and no need to resort to substitutes as extensively as the woolen manufacturers asserted. The government specifications for army cloth, however, permitted the use of 50 per cent. shoddy for overcoatings and blankets and 35 per cent. shoddy for suitings.

The shoddy industry was in times of peace normally a small one. In 1909 (1), there were twenty mills in Pennsylvania, fifteen of which were in Philadelphia. In 1914, according to the U. S. Department of Commerce (2), there were sixty-four establishments in the United States.

Wool fibre manufacturers urge (3) that if all the pure wool clipped in a year were made into garments without the help of shoddy and equally distributed, there would be only 14 ounces for each individual, sufficient to make a single pair of knee breeches per person.

Shoddy, as defined by the U. S. Census for 1900 (4), is the fibre recovered from woolen, worsted, and mixed rags known under the generic name of shoddy and subdivided into shoddy, mungo and flocks. Shoddy is usually made from soft woolen rags or from new clips,—i.e., clippings from tailors and clothing factories; mungo from hard worsted rags; and flocks from very short, unspinnable wool fibres derived from the lower forms of mill waste, shearings from cloth, or from old rags. Mill waste with long fibres is also reworked.

Invented by Benjamin Law of Batley, England, in 1813 (5), shoddy was at one time known as "devil's dust," and a machine essential to the industry is still known in the trade as the "devil." Conditions found in early stages of manufacture in several establishments show the term to be well chosen.

Early in the year, the government took

*The eighty-two mills employed 14,905 people, of whom 8,092 were men and 6,813 were women; 3,717 of these men and 2,857 women worked in New Jersey mills. In fifteen Pennsylvania mills and three New Jersey mills, no women were employed. Of the eighty-two mills, thirty-two made wool or worsted yarn, ten made cloth and blankets, eight made wool shoddy only, one made wool and silk shoddy, three were wool-scouring establishments, and twenty-four made cotton and wool waste for wiping machinery and for packing journal boxes of locomotives, four made miscellaneous products

over the entire wool clip for 1918, and fixed prices, establishing a special woolens section in the War Industries Board. Shortly after, it fixed prices for woolen rags and for new clips from woolen garments and appointed a special Administrator of Woolen Rags and Fibre. A large Base Sorting Plant was established in New York City to receive clips from manufacturers of soldiers' uniforms and clothing, and redistribute them among manufacturers to be reworked into shoddy cloth for army use. Six hundred thousand pounds of clips were received weekly.

Bernard M. Baruch, Chairman of the War Industries Board, appealed on October 24, 1918, to all American housewives to save everything: paper, rags, scraps of all kinds. He stated that the National Waste Reclamation Section of the War Industries Board had been organized and a plan formulated for the collection of waste. Among the objects desired, he enumerated cotton and woolen rags. The Associated Press reported that "children have been appealed to, to gather paper and cotton rags, and every family to join in the movement to help the local reclamation council take up the work." As appears later, sinister aspects of the work of the children developed.

RAGS

"The wide world is laid under contribution by the rag merchants. Hither are brought tatters from pediculous Poland, from the gypsies of Hungary, from the peasants and scarecrows of Germany, from the frowsy peasants of Muscovy, to say nothing of snips and shreds of monks' gowns and lawyers' robes, from postillions' jackets, and soldiers' uniforms, from maidens' bodices and noblemen's cloaks. A vast medley, truly, and all to be manufactured into broadcloth in Yorkshire. . . . (6).

"I discovered that pilot cloth, . . . glossy beavers and silky-looking mohairs are shoddy; that the Petershams so largely exported to the United States are shoddy; that the delicate cloths in which ladies feel so comfortable, and look so graceful, are shoddy; that the fabric . . . of garments in which fine gentlemen go to the Derby or to the Royal Academy Exhibition or to the evening service in Westminster Abbey is shoddy."—*A Month In Yorkshire* by Walter White (6).

The centers for the "rag medleys" in this country are New York, Boston, Chelsea, Mass., and Philadelphia. Rag shops abound in the latter city. They range from rag holes opening up from the sidewalks like so many rabbit hutches, to large wholesale establishments whose business is counted, not in coppers, as the old clothes man counts his, but in thousands of dollars a year. The U. S. Department of Commerce (7) reports that in 1917 there were exported from this country 13,671,472 pounds of woolen rags valued at $1,629,130. In 1913, twice that number of pounds had been shipped, valued at scarcely half as much. This indicates the value of rags in war-time. Even on farms, 20 or 30 miles from the railroad, rags formerly first worn to tatters and then used to rub horses, or to clean machinery, were now sent to the nearest towns to be sold.

Few industries are so loosely organized and few so highly specialized in certain parts as the rag industry. The lowest unit is the rag peddler who collects from door to door and gains a precarious dollar, or dollar and a half a day. He sells his pack at so much a pound untouched, or he may sort it and get much more for it. His business is a family affair, his wife and children helping to sort and frequently to collect, the children especially being encouraged to pick up rags from dumps, from barrels, from the street, or wherever they can be found. The peddler's customer, the rag or junk dealer, whose shop is only a little less fetid than the peddler's hole, re-sorts the pack, bales it and sells it to the jobber or small dealer, who in turn sorts, bales and resells in wholesale lots. His customer may be another dealer whose line is more narrowly specialized, or he may deliver direct to the shoddy mill. Frequently, woolen rags go to the woolen rag grader who may sort them into as many as fifty different grades. There are many divisions among dealers; one specializing in cotton rags, another in rough woolens (men's suitings), another in soft woolens (underwear, women's clothing, knit goods, etc.), still another may not handle old rags, but only new clips, tailors' clippings and the like.

In Philadelphia, the Bureau of Health attempts to control the rag business by ruling (8) that all rag or junk shops must be licensed; that they shall not be occupied as dwellings; that rags shall not be sorted in a manner to permit the escape of dust or dirt; that rag shops shall not receive, keep or store fats, bones, or fertilizing products; that public highways shall not be used for sorting rags, paper or junk; that old clothing must be washed and disinfected before being resold. But what

regulations does Philadelphia enforce?

To see the surroundings of raw materials used in making government supplies, fifty-nine "rag establishments" in Philadelphia were visited, peddlers' cellars, rag shops, jobbers or petty dealers, wholesale houses and woolen rag graders. All these were indescribably bad as regards dirt, sanitation and ventilation. Women were working in the most primitive fashion, seated on old barrel staves, on makeshift stools, or on the floor with odious piles around them. In some places they wore head coverings of rags. These afforded little protection, however, for unutterable filth was everywhere, dust flying from the rags. The toilets were repulsive. None of these shops appeared to employ women more than ten hours a day, but usually only half an hour was allowed for lunch. The following reports are typical:

No. 1.—Sorts woolen rags into thirty-three different varieties and sells these special bales to shoddy factories. Employs six women graders at $8 per week. The forelady took me to top floor where women were working. They sit on improvised seats, no backs, and sort into different baskets. Rip out wool strips or linings—this raises more dust than sorting.

A great loft probably 100 feet long by 40 wide —windows at either end. Large wooden bins on each side in which baskets containing different grades are emptied. Women sit in center of the room, with piles of vari-colored rags about them on the floor. A place of ancient and dead things. The women seemed as old and forgotten as the rags they were sorting. Pale sunlight flickered in the windows at one end but was lost before it reached the workers.

A litter of empty milk bottles and dirty dishes on a box showed the remains of luncheon. A bucket of drinking water stood hard by.

A scrawny creature, her spare grey hairs straggling out from under her cap and an ugly cough shaking her, took me from bin to bin, explaining their contents. She had begun work at 16, and although only 38, was old and broken. The former boss of the place, she said, had retired after making millions from rags. Her $8 a week did not go far at home. "It don't seem right, does it, and us that helped him make it still sortin'! If the government could take over the longshoremen, why couldn't it take us rag sorters?"

No. 2.—Junk and rag shops, conducted by an Italian, smell and look like hundreds of other rag shops throughout the city. The odor of new filth mixed with dirt of rags, and musty, murky smells of damp rags picked from gutters and deserted cellars greet one before crossing the threshold. Dust and dirt rise when piles of these rags are moved about, a continual procedure, as the wagon brings in new piles and these in turn are separated into small lots for the women of the neighborhood to take home and work on! On this street children, dogs and goats find stray rags about the entrance of the shops and scatter them over the neighborhood."

In the negro quarter, rags are sorted on the sidewalk, and stored in basements or cellars of houses used as dwellings. The shops in this neighborhood were among the worst found.

No. 3.—A two-story dwelling on the first floor of which are bales of hay, rags, paper and junk, and two horses. The room is about 20 by 20 feet, filthy and reeking. The peddler who lives with his wife on the second floor was sorting the "stuff." His face was covered with running sores and appeared very painful.

The scavenging evil in Philadelphia is not controlled. Children may be seen picking from ash barrels, dumps and wharves, rags which they sell to junk dealers, who in turn sell to the mills. Some manufacturers insisted that their stock was clean because they used no old rags, but new clips from garment manufacturers and tailors' shops. Since, however, these clips are usually swept up from floors covered with dust, sputa and dirt of all kinds, it is obvious that the term "new" covers a multitude of germs.

The National Association of Wool Fiber Manufacturers in a statement published in 1918 (3), to minimize dangers to health in shoddy manufacture, pointed out that carbonization which removes the cotton must destroy disease germs. But rags or clips are carbonized only when cotton is present in them and the process is not always applied. Of fifty-one shoddy, yarn or cloth mills, only three had carbonizing tanks; in the remaining ones where shoddy was made, the rags or clips were fed direct from the bales into the machine. Disease germs which may have existed in the raw materials have in the finished cloth been destroyed in the fulling and, when applied, in the dyeing process. To the ultimate consumer, the danger from these sources is therefore nil. There is no such safety for the workers or for those consumers who use wiper-waste, cotton batting and other waste products where the yarn is neither dyed nor fulled.

Some employers said they could not use women in shoddy manufacture, the work is too unpleasant and dirty. Women were found, however, in other places—largely in the sorting process; and in one mill colored girls were employed at rag pickering machines. Many women tended cards, also a process in shoddy manufacture.

The other processes in which women were engaged in 1918 included the following: sorting waste and wool; gilling, combing, drawing, backwashing, mule spinning, ring spinning, winding, reeling, spooling, twisting, doffing, warp preparing, drawing-in, beaming, weaving and finishing. In these processes, women have always been employed, not merely in war time.

FIG. 1.—Feeding cards in a large blanket mill. These girls were replacing men but machines were not made more safe. Note exposed gears and bolts.

MILL CONDITIONS

The most striking feature of many Philadelphia textile mills is their age. The next is their general gloom and dirt. Some of those visited were built as far back as 1840, many before 1880, and only a few since 1910.

Manayunk is a large mill section in Philadelphia where the most ancient establishments were found. The mills are in a row, of dismal grey stone, all alike, set one after the other in the valley along the Schuylkill River. Even factories built in recent years follow the type of the neighboring mills; grey stone outside, and inside, low studded ceilings, whitewashed or plain brick walls; windows which have apparently never been washed; narrow wooden stairways, dark with dirt. Roadways to the mills are frequently obstructed with rubbish. Heavy dirty bales block the doorway, and if one goes by at the noon hour, one often finds the workers, for lack of lunch rooms, eating on these unsightly piles, or lounging upon them. The following excerpts from reports are typical:

MILL 1.—Miserable old mill surrounded by railroad yards, warehouses and stables. Mr. Z. said he had been there for thirty-eight years, and it was an old mill then. It is entered through a steep, badly cobbled alley. It has small, dirty windows and no attraction of any sort. Some girls must climb four flights of stairs. Machines are crowded close together. The walls are dark and dingy; the foreman said, "I've been after them to paint up for a long time, but they've

been so busy since the war began they've kept putting it off."

MILL 2.—Mill of most ancient design and structure. Flight of rickety stairs leads from ground to first floor; stairs littered and dirty, walls dirty, windows unwashed. The picker room was, however, spotless; the man in charge is an old Englishman who has been with the firm since 1865 and is extremely proud of his department.

Mills elsewhere in the city are perhaps less sodden in appearance, but for the most part little better. One which had enormous orders for government cloth is in a mill village of the old fashioned type:

The mill was built, no one knows when, but before 1843 when the founder died. It is set in a deep gully formed by a sluggish stream, 15 to 20 feet wide. Many company houses are both down in the valley and farther up on the hill, variously constructed of wood, brick and stone. Water must be carried both for mill and houses from a spring at least 100 yards from the mill and several hundred yards from the most remote house. Access from houses to mill is by rough paths or unpaved roads, now ankle deep in dust. Outdoor privies only are provided. Waste water from the mill is led through open sewers to the creek.

The largest, and in some respects the worst textile mill was in New Jersey. In it were employed 5,516 people, more than one-third of the whole number included in this study. Of these, 230 were children under 16 years of age. This mill had been owned and operated by Germans and was, therefore, under government control at the time of the investigation in August, 1918, having been commandeered some months previous. It covered many acres surrounded by high brick walls with iron gates. This great plant, although clean and well kept, was notoriously lacking in provisions for the welfare of its workers. Light and ventilation were shocking, many rooms lacking windows and depending for air and light on high skylights. In the wool-scouring room, which was kept at an extremely high temperature, women formerly did the heavy work of receiving the wool after it had been scoured and dried. Their employment had been discontinued for under the combination of excessive heat and heavy work, "they did not get on very well."

Because of the massing of machinery in large rooms, the noise was deafening, particularly in one huge room filled with gilling and combing machines. No seats were provided. The workers looked beaten and crushed under the combined strain of noise, heat and constant standing. Women at lunch time sat on the floor, too exhausted to eat. There was no lunch room. A foreign woman, when asked about the flushing of the primitive vault "toilets," answered simply, "The water, she stink!" There were no dressing rooms, and the investigator watched women and girls changing to their street clothes in the workroom where men were constantly walking about.

This disregard of comfort and health of the workers and failure to supply their most elementary needs contrasted sharply with a care for the quality of product and for mechanical efficiency unequalled elsewhere. Records of the approximate labor turnover were kept. An employment bureau had been established, and all workers were obtained from the Industrial Council of Woolen Manufacturers, whereby a uniform wage was maintained throughout the district. Because of the workmen's compensation law, a doctor's office had been fitted out and all new employees were given a physical examination. By these means, the management aimed to control labor conditions and to protect itself from interruptions due to frequent changes in the working force, and to losses through the operation of the workmen's compensation law.

No shoddy was used in this mill, the company not considering it a fit ingredient for a high-class product. The only material mixed with virgin wool was their own mill waste.

ACCOMMODATIONS IN THE MILLS

Accommodations in the mills were in keeping with their exteriors, as the following pages show:

Toilets.—The Pennsylvania law (9) specifically requires toilets in all establishments employing women. For every twenty-five women, one toilet must be provided with adequate light, ventilation and screening. Of the forty-eight places revisited in November, only four failed to provide a sufficient number of toilets. In construction and condition, however, twenty-three fell short; many toilets ventilated directly over the top of incomplete partitions; others were improperly screened and in seven they were dirty, ill-smelling and ill-ventilated. For several

mills the toilets were merely outside privies. In others a common trough was found with two or more holes set in the top without any attempt at isolation. In the large New Jersey mill, the toilets surpassed in degradation anything that could be imagined. As this mill had no dressing or rest room, the women's only refuge from the crashing machinery and endless blinding rows of revolving bobbins was the toilet rooms. An attempt had been made to remodel these in several departments, but in some others groups of ten or twelve Polish women were trying to steal a few minutes rest by sitting over a narrow board, in which holes were set over a common trough, flushed automatically at intervals. The compartments measured about 16 by 6 feet and had no outside ventilation. The superintendent explained that it is "useless to provide decent toilets for that class of workers."

In July and August, twelve mills had toilets in first class condition, twelve poor, and nine degraded. In three, conditions varied in different parts of the buildings. In twenty mills the toilets were fair. Of the six New Jersey factories employing women, two were good, two fair and two very poor. In eight mills, toilet conditions could not be learned.

Dressing Rooms and Washing Facilities.—Dressing and washrooms are specifically required by the Pennsylvania law (9) in all establishments where women work. These were either in the vestibules of toilets or in a rough partitioned off space in the workroom. They usually consisted of bare boards, with a row of hooks for clothing and occasionally a chair or two. Where large numbers of girls were employed, they complained that dressing rooms were overcrowded. Many ran home in their mill clothes. A number of mills had no dressing rooms, workers hanging up their clothes next to their machines. In a mill where girls wore uniforms when piecing on spinning mules and there was no place to change to street clothes, a foreman piled up packing boxes for shelter. Even then a girl complained "the brazen fellers stood round and stared—they wanted to see how I put them on." Many workers were dressing before their machines at closing time, the men more freely than the girls. "You have to walk through the room with your eyes shut," a woman said.

Adequate dressing rooms were rare indeed. In eleven factories such meagre provisions as have been described were lacking entirely or were provided only for some of the departments employing women. As for washing facilities, the workers in the forty-eight establishments revisited fared worse. In fifteen the legal requirements of a separate wash room were wholly ignored, and women vied with men and boys for a place at the workroom sinks. In one, pails and cans without outlets were filled with water, which, with increasing degrees of density as the day wore on, provided the only means of "cleaning up" for several hundred women.

Many girls visited at home complained of the toilets and of the lack of washing and dressing accommodations where they were employed. A colored worker in a waste factory where conditions were indescribably dirty, said that there was only one sink for thirty-five girls. The floor under it was always flooded with water and they caught cold from wading through it. One girl said the mill was a "dirty old place" but there was no use changing as others were no better.

Rest Rooms.—The general attitude of employers towards rest rooms was, "It is hard enough to get them to work without providing a lounging room," or, "Oh, I suppose they'll even be asking for that if they happen to think of it," or again, "Workers don't care for comfort, they're only after big money."

Only one mill provided even a couch, though the work involves long hours of standing and the strain of unbroken attention to machines running at high speed. One girl who is head tender on a mule, an impossibly heavy job for a woman, said that occasionally she had a chance to "bum" while waiting for yarn from the carding machines. "What do you do then?" "Oh, I usually drop off to sleep," she answered, "on the window sill or wherever I can find a corner." The sight which greeted the investigator on entering one yarn mill was that of three or four negro men sound asleep at the noon hour on dirty bales of rags in the doorway, and just inside, a half dozen white girls who had flung themselves down in exhaustion on piles of yarn which they had been reeling into skeins.

An employer genially stated that "the

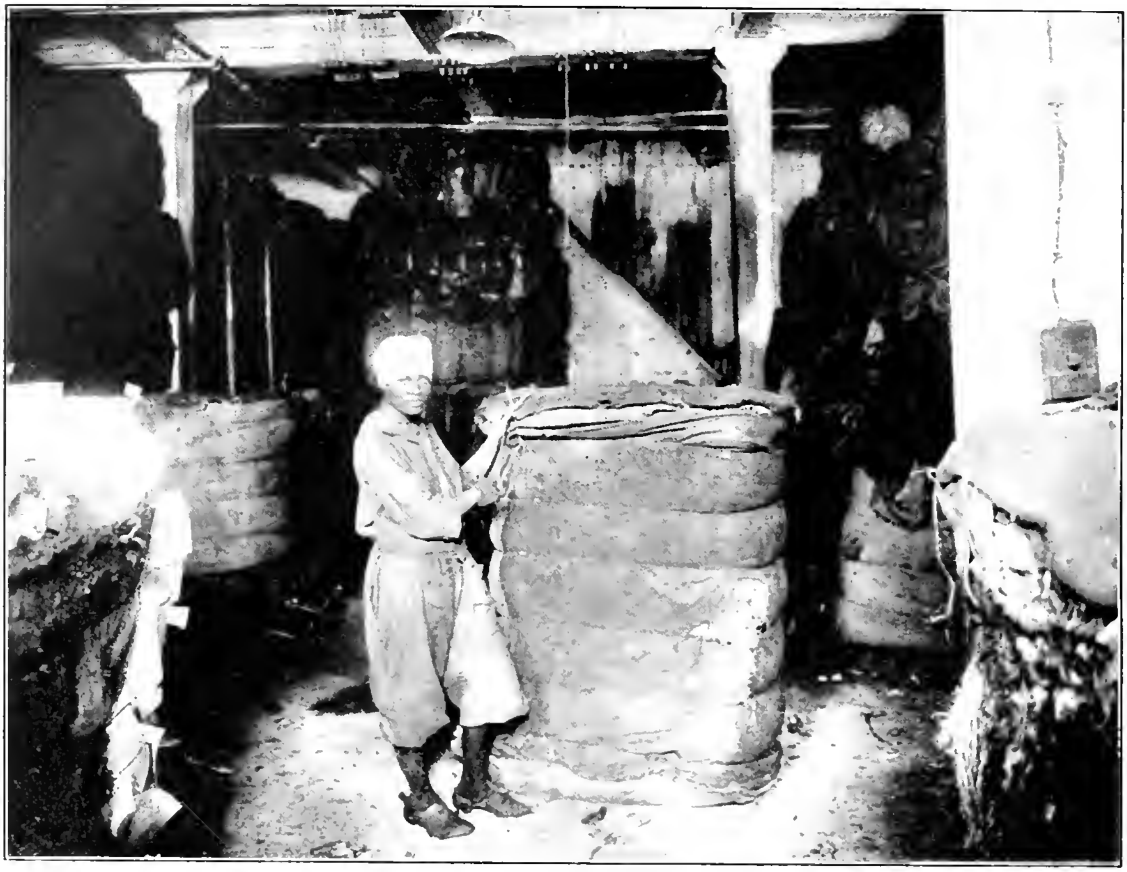


FIG 2.—Sewing tops on bales in a waste mill. This girl took a man's place.

girls flop down anywhere when they catch up with their work. No one need fear that a mill girl will overwork." A second met the suggestion that provision for welfare and comfort promoted efficiency, "I'm not looking for high brows, I want working-class people used to working-class conditions and willing to work hard."

Lunch Rooms.—Though the Pennsylvania law (10) does not require a rest room, it does provide for a lunch room "in any establishment where . . . injurious fumes, dust or gases shall be present." Among forty-eight Pennsylvania factories revisited, only one had a lunch room. A New Jersey mill had had a lunch room but had appropriated it for storage space. In no other was a place set apart where employees might eat their mid-day meal, although in fourteen the work created so much dust as to make some such provision indispensable. Most of the workers either went home or ate cold lunches at their machines, on the window sills, on the stairs, or over the filthy bales of waste or rags. One mill afforded a gas stove and a coffee percolator in a corner of the weave room.

Hospital and Emergency Rooms.—Two mills only, both in New Jersey, provided hospital or emergency rooms. In one, the reason advanced was the compensation law and the fact that many employees had claimed damages for hernia due to heavy lifting, "So now we examine all of them physically when they first come to work."

Seats.—Omnipresent in Pennsylvania mills was violation of the labor law (11) requiring seats for women. Seats are not expensive and not difficult to install, and there is no reason for this neglect except the traditional formula of manager and foreman that "the girls haven't time to sit down," or "the seats would be in the way." Few factories are without space for small seats at the ends of aisles. The frequent sight of girls squatting on filthy floors of toilet rooms, or resting against a pile of waste or on a chance box in the workroom proves that they would use seats. There are few textile processes where a woman

could not snatch a rest when her "ends are up." Of the forty-eight plants in which this matter was carefully noted, twenty-nine provided no seats at all; in sixteen others, women used boxes and bales, or occasionally a few stools scattered about. Six had properly obeyed the law, but these, with one exception, were small plants employing less than twenty-five women.

HEALTH HAZARDS

Lizzie Smith with her ugly cough, is a sorter in one of the oldest cloth factories near Philadelphia. Established about 1850 by an Englishman, it has remained in the same family ever since. The workers are of English stock except a few Italians and Austrians recently introduced, and the community much resembles an old mill village in England. A woman employed here over thirty years does not remember any changes of any kind.

Lizzie is one of three or four women who sort woolen rags or tear up old carpets before they are converted into shoddy. This work is done in exactly the same way as in the early part of the last century. Two women hold a piece of carpet and a third cuts it into strips with a carving knife. The material is filthy and clouds of dust fill the air. No disinfecting or cleaning of the rags is attempted before they are thus handled. The Pennsylvania Department of Labor and Industry investigated and ordered all employees in the carbonizing department who are exposed to dust to wear respirators. But the order seems never to have been enforced.

When Lizzie leaves the mill, dust covers her from head to foot, her hair, her eyelids even being grey with it. Tuberculosis runs in her family. Her husband died of it and her little boy of twelve years has been pronounced a hopeless case. She herself coughs steadily and complains of the irritation caused by working in the intensely

FIG. 3.—"Knocking off" is the last operation in carding. Girls remove spools of yarn as they fill—one every twenty minutes—and carry them to the mule room to be spun. The spools weigh about 18 pounds and are unwieldy. This picture shows the makeshift dressing room partitioned off at one end of the work-room.

dusty atmosphere of the mill in question.

The relation of tuberculosis to the inhalation of organic dust is much discussed by medical authorities. Schereschewsky, in his report on the health of garment workers, believes organic dust quite capable of causing pathological changes in the lungs.

Hayhurst in his *Industrial Health Hazards and Occupational Diseases in Ohio*, 1915, says, "A tuberculously inclined person subject to dust, if the processes did nothing more than irritate the nose and throat, is almost certain to see an increment in his disease . . . . Dust in general produces a chronic catarrh of respiratory and digestive organs, resulting in a lowered resistance of the damaged parts and inviting secondary diseases which are usually the cause of death." Landis, in a recent number of this Journal, states that inhalation of organic material *per se* has not been shown to produce pathological changes in the lungs. He limits this statement, however, to *pure* organic dust which he holds, *with rare exceptions*, incapable of causing structural changes in the lungs. He points out that there is frequently a high death rate from tuberculosis in certain trades in which organic dust is plentiful, calls attention to the fact that organic dust particles are often contaminated by inorganic particles, and emphasizes the need of more and better studies—intensive studies—of this type of dust, with especial reference to the part it plays as a carrier of bacteria. He dwells upon the danger arising from the presence of active open cases, careless in regard to expectoration in dusty workrooms.

Lizzie Smith is an instance much in point. She has lived with tuberculosis. She has a bad cough and is herself a tuberculosis suspect. She handles material filled with fine inorganic dust and liberating it in clouds as the cutting is carried on. Such an individual is not only a fertile source of tuberculosis in her fellow workers but is in surroundings which can hardly fail to shorten her own life. The two following reports exemplify tuberculosis-breeding conditions met with over and over again in the course of the survey:

Mill 1.—Four colored girls were in a dark basement feeding rag picking machines. The dust and vapor from the operation was intense. Back of the picker was a "gauze house" which received the pickered stock after it had passed from the machines. The operative would stop feeding dirty rags into the picker and go back into the "gauze house" to rake out stock and pile it on the floor outside, whence it was carried by men to the adjoining card room. The stock was black wool shoddy. An ice cream man went by and the employer let one of the girls run out to buy cones for the rest. This, he said, was a daily occurrence. The girls ate the cones without bothering to wash. The intentions of the boss were no doubt kindly, but a more unhygienic eating place can hardly be conceived.

Mill 2.—In this room bales of old household rags were opened, starched collars and cuffs being thrown to one side. These discarded parts, dirty from use, filled one side of the room, piled up 3 or 4 feet high. This place was anything but pleasant. Three or four girls handed out material from bales to a man at the first cutting machine. The material then fell through a chute to the second floor to the picker machines. The floor of the lower room was covered with piles of rags 2 or 3 feet high, which were constantly being sprayed by a young colored girl with oil from a hose. The oil, which kept down the dust to some extent, was not used for this purpose but to facilitate the shredding of the stock.

This room was filled with dust and flying dirt; the machinery, windows and window ledges were covered with it. In winter, when windows cannot be open, conditions must be far worse. Mr. Q., although willing to let us see the mill, said, "Unless you have been in a shoddy factory, you will probably be shocked at the dirt."

How unpleasant the workers found the dust, they showed by attempting to protect themselves, tying old pieces of cheese cloth over nose and mouth. One old man had covered the lower part of his face with a ragged piece of Nottingham lace curtain.

The Philadelphia Bureau of Health attempts to record the occupations of people who die of tuberculosis. One of its representatives stated, however, that many cases were not reported, and that frequently while that ailment was the main cause for disability, the worker died of some other disease. So many patients were discovered in Kensington—the largest mill section of the city—that the State Department of Health has established a tuberculosis dispensary there.

There is some direct relation between the textile industry as our agents observed it and pulmonary tuberculosis. In shoddy workers there is nothing mysterious about this relation. Not only are unclean and contaminated materials handled, but a worker with tuberculosis actively employed in the surroundings which go with shoddy finds a most fertile atmosphere for the spread of the disease.

Few precautions against the dust evil appear to have been taken in the mills visited. The Pennsylvania law (12) requires that proper exhausts be provided in all establishments employing women, where

"poisonous or injurious dust, fumes or gases are created by the machinery or material." Under this law, the dust and lint which fill the air in certain forms of manufacture clearly require removal. Usually there is a blower with a hood attached to the picker machines. This is fairly effective, though in all the mills visited only three picker rooms were free from dust. In other processes of manufacturing, carding, sorting and combing, this dust-removing provision was lacking. In these operations, if it is not practicable to attach blowers to the machines, some system of forced ventilation by exhaust or ventilating fans should be employed. "It can't be done" is the usual protest of manager and foreman to this suggestion. They explain that a strong current of air would blow the fibre, break the fine threads on the spinning frame, make work more difficult. But it is obvious that no consistent effort to isolate dusty processes and solve the dust problem has been made.

Of the forty-eight factories revisited in November, thirty-five provided picker hoods and exhausts, and five had no dust-removing devices. In twenty-one establishments the systems were inadequate. In three, the dusty process was sorting, for which no excuse for lack of ventilating fans can be offered. In four mills, the dust was comparatively slight; in seventeen, conditions were serious.

We may reemphasize the fact that in these factories the danger of dust is intensified by the germ-laden material in the factories. No disinfection of rags or clips takes place with the single exception of the government distribution and reclamation plant for clips and old garments, where cotton rags are washed after the first preliminary sorting.

Heat and Humidity.—In sixteen mills the heat and humidity were excessive. In the backwashing room of a large manufacturer of government cloth, the superintendent admitted that women fainted from the combined strain of heavy work and dense atmosphere. Such conditions not only increase the susceptibility of workers to disease, but according to Dr. Frederic Lee (13) reduce output as much as 20 per cent.

Other Strains.—Other serious health hazards commonly threatening the women in the mills studied were: lifting or carrying weights; overwork and speeding up; continuous standing; bad lighting and noise. A girl of 19 years was headtending a heavy woolen spinning mule, a task far beyond her strength and one which in most mills is performed by a man and two piecers. She had only a 16-year-old piecer to help her and had frequently to run the entire machine alone. Girls were running woolen cards, and doffing the 5-foot spools on the condenser cards. In waste mills, colored girls were pulling waste from piles 10 feet high. They were also lifting and turning heavy bales.

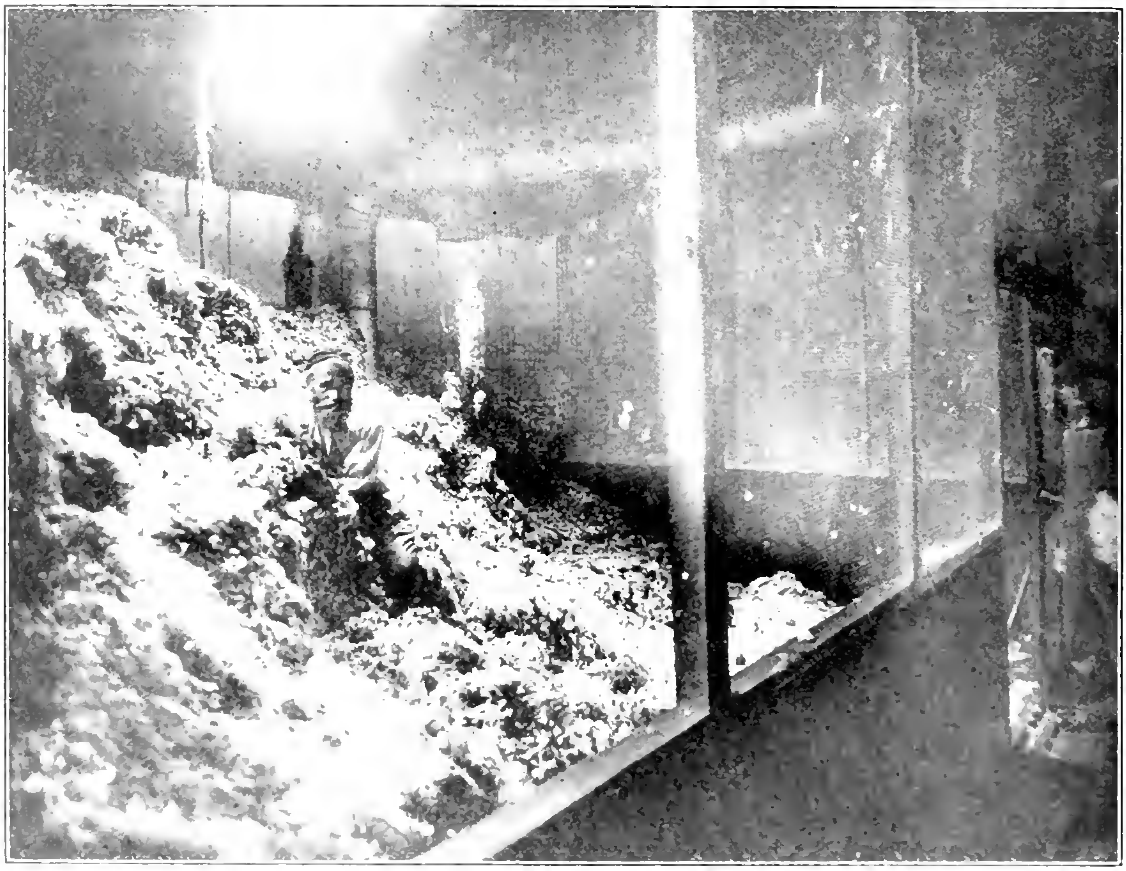
Whether or not the work is heavy, operatives must stand in practically all processes above rag sorting. Mule spinning not only involves standing but also walking back and forth many miles a day with the mule carriage. Winding, reeling, spooling and twisting machines also demand continual standing and unremitting attention. Obviously all operatives should be given rest periods at regular intervals. At present, however, not even proper seats are provided.

Lighting was bad in many rooms, particularly those filled by heavy machines commonly placed between the operatives and the light. Women were working in basements and cellars, where the poor light was still further diminished by unwashed windows blocked by heavy bales. Many girls reported eye-strain from burling, drawing-in, and from winding and spinning where the operative must watch innumerable strands of twisting yarn. The crash and roar of machines was also a continual strain, many women appearing blighted and dazed by the noise.

In addition to these constant strains, which sapped physical endurance and vitality, the workers were in imminent danger always from unguarded machinery. A number of disasters were reported from picker machines, and cards especially. In forty-eight plants reinspected, two employed no women on machines, three showed only minor neglect, and twenty-two had unguarded power transmission machinery.

Employers' Responsibility.—If no system of ventilation can wholly remove dust, and relieve the work of excessive heat and humidity, and if the other strains cannot be abolished, this is all the more reason why the textile industry should, (1), provide decent lunch, dressing and rest rooms

for women obliged to work under such conditions, and, (2), reduce hours of work to a maximum of eight in one day and forty-four in one week. Instead, the employers who have maintained health-shattering conditions have, for the thirty years since 1889, consistently opposed the enactment of laws to counteract or mitigate these evils. In May, 1899, the editor of this study appeared before the Senate Committee on Labor at Harrisburg, in support of a bill to abolish night and Sunday work, and to establish a ten-hour day for women and minors. This bill did not become a law until 1913, twenty-four years after its first introduction. In 1917 and again in 1918, Pennsylvania employers successfully opposed an eight-hour law for women and girls employed in manufacture.



[illegible] The [illegible] room of a large blanket mill with shoddy and wool stock ready to be carded and spun. The manager of this plant told of the difficulty of getting help and said that for this end of the industry they employed a special man to round up the "bums" at missions and other refugees of "down and outs."

Long Hours.—In not one mill was the eight-hour day considered, in spite of the recognition of it in principle by the War Labor Board and leading industries throughout the country. The twelve-hour day is too recent in textile tradition, having persisted until 1913. The Pennsylvania (14) law now permits a ten-hour day, a fifty-four-hour week, but prohibits night work by women. Thirteen plants violated the law, one large blanket mill allowing women carders to work all night. In New Jersey (15), women may legally toil sixty hours a week and all night long. Two large mills had night shifts.

These long hours remain, in spite of the avowedly harmful features of the industry, which employers characterize as inevitable. And they contrast painfully with other industries, free from the perils of dust, humidity and heavy labor, such as the bindery trade with its long established forty-eight-hour week, the garment industry with its forty-four-hour week, the hat and millinery trade with forty-eight hours for

piece, and fifty hours for week workers. Organization of the workers to gain shorter hours and better wages has been bitterly opposed by the manufacturers, who have, however, closely organized themselves.

A Belated Industry.—From the foregoing cumulative evidence of conditions in the eighty-two mills studied, it appears that certain branches of the textile industry in Pennsylvania and New Jersey—and as will presently be shown, also in Rhode Island—are unstandardized and belated. Avoidable fatigue, filth and bad air, danger to life from practices obsolete elsewhere and in defiance of the law—these are among the attributes of the textile industry as they were of the formerly sweated garment trades. Closely interlocked with the making of woolen cloth is the shoddy industry which violates every hygienic standard in every process.

Specific legislation to offset these menaces to health and efficiency is proposed at the end of this article. The suggested amendments to the sanitary law are as much needed in Pennsylvania and New Jersey as in Rhode Island, except that in the former states, discretionary powers are not given to factory inspectors.

In the interest of public health, also, steps must be taken to control the shoddy industry. The war is over, the pressure for volume of textile production for the army is at an end. Shoddy produced henceforth will be for civilian use. The competition of goods thus adulterated will tend, as always, to discourage both wool growing and the production of honest woolen cloths. American working people will continue to be clad in textiles of less value for warmth and wear than honest goods afford. Why should this be tolerated?

For the protection both of workers in the industry and of the consuming public, a bill for honest cloth will be introduced during the present Congress. It will require that, wherever reworked material is used, a thread of different color must indicate the fact. The purchaser can then buy textile products intelligently, safeguarded against misrepresentations. Hitherto, the customer has had no effective means of discriminating in favor of honest goods, especially the buyer of ready-made wear. In vain have teachers of domestic science shown their pupils how to detect the presence of cotton thread in woolen goods. A ready-made cloak or skirt could not be tested by fire or acid across the counter. Equally unavailing have been efforts to label shoddy cloth. Only the incorporation in the texture itself of the tell-tale colored thread will enable the public to decide effectively whether it will encourage or discourage this filthy industry. Agitation for honest cloth will keep the light turned on, and may arouse the public conscience to the necessity for establishing standards ensuring health and efficiency for the workers in this old and neglected area of employment.

II

WOMEN WORKING AT NIGHT IN RHODE ISLAND

A Study of Night-Workers Employed in Thirty-Nine Textile Mills

Rhode Island is geographically the smallest state in the Union. It is the most densely populated, with 96.7 per cent. of its inhabitants living in cities of 2,500 (16) or more. Of the girls between 16 and 21 years, 67 per cent. are engaged in industry; and of all the women in the state over the age of 16 years, 32 per cent. are employed. These percentages are higher than the corresponding ones in any other state (17). Rhode Island is, therefore, convenient and economical as a field for investigation.

This study of women working at night in thirty-nine Rhode Island factories was, however, undertaken because in 1916, 1917, and again early in 1918, successive legislatures killed a bill intended to prohibit the employment of women at night in manufactories.*

The number of women working at night in all industries throughout the state in the fall of 1918 appears, according to the statements of employers, to have been approximately 2,000. It seems fair to assume that this number is larger than during normal times, but unfortunately no separate record of night-workers is kept by the Rhode Island Bureau of Industrial Statistics, and comparison with former years is, therefore, impossible.

Although Rhode Island is in total popu-

*In 1919 this bill was killed for the fourth time.

lation little more than a good sized city, and in extent of territory little larger than a fairly big county, industrially it is highly developed and in textiles particularly has taken extraordinary rank among the states. The United States Department of Commerce from its census of 1914 reports: "Rhode Island ranks fifth among states in the value of products of cotton goods; third in that of woolen and worsted goods; fourth in dyeing and finishing textiles." These considerations also contributed to make Rhode Island especially suitable for our purpose.

From the middle of September to Christmas, 1918, with the approval and aid of the Secretary of War, the survey was carried forward. The aim of the League was not to gather statistics but to understand certain human aspects of this industrial usage. The investigators visited 244 women in their homes in different parts of the state and talked with them about the circumstances that had led them into night-work. Textile mills where women were employed all or part of the night, or in the early morning and evening were visited. Most of these mills were seen both during the day and during the night, by day to talk with the manager and in the evening to observe the women actually at work.

The following pages suggest what these tired-looking women who come to the factories at night have been doing in the hours away from the mill.

In Rhode Island, industrial life appeared to be little changed by the war. Women were not seen working in ticket offices or along railroads or on trolley cars. Many factories, however, busy before the war with civilian trade, were now weaving heavy cotton cloth for the tires of army trucks and silk for powder bags, spinning stout thread and strong yarn for socks and uniforms, and braiding laces for army shoes.

As it was impossible to buy new machinery or to make additions to the plant, employers, unhindered by a night-work law, proceeded to expand by using overtime and night shifts. Many women went back, for the first time since marriage, to places they had left years ago. Although their hands had not altogether forgotten their old skill, they failed numerically to satisfy new demands for emergency production, and employers complained bitterly of inexperienced labor. It was not possible to ease the labor shortage by taking on women in men's places, because women have always been used in the textiles wherever possible. An employment manager in a large factory explained what he considered the inferior type of employees in the textiles, by maintaining that the better class of strong young women had all gone into munitions. This was hardly justified by the facts for skilled textile workers were earning better wages than munitions work paid.

Of the 244 women night-workers visited at home, 135 were married, 80 were single, 29 widowed, deserted or divorced. The high cost of living was the reason most often assigned by the married women for working, and the wish to be with their children by day, the reason for choosing the night shift. A few were tempted by the larger wages, and others were influenced by their neighbors who had made the venture.

The Effects of Night-Work on Health

Obviously in a study of night-work the amount of sleep the women have is of most immediate interest. It is generally recognized that day sleep does not give the refreshment of night sleep (18). The table given below shows the hours of day sleep of 156 night-workers as stated by themselves.* These women were, for the most part, in favor of night-work, and felt ap-

Hours of Day Sleep of 156 Married Women Night-Workers

Hours of Day Sleep	No. of Women
1 hour and less than 2	1
2 hours and less than 3	5
3 hours and less than 4	19
4 hours and less than 5	23
5 hours and less than 6	41
6 hours and less than 7	25
7 hours and less than 8	25
8 hours and less than 9	11
9 hours and less than 10	5
10 hours and less than 11	1
Total	156

*Eight gave answers too indefinite to be recorded

prehensive that the investigators might be against it. They were, therefore, more likely to overstate their hours of sleep than to minimize them. The figures are as they gave them, although often the obvious conditions of the household rather belied them.

Forty-eight married night-workers, then, were having less than five hours of day sleep, and eighty-nine less than six hours, two hours less than the eight (19) which most hygienists agree is the night sleep required by the average person. Furthermore, seventy-four of this number took their pitifully short hours of rest not in one period of refreshing sleep but at different times, getting up in the intervals to prepare meals or to look after the children.

Many of them had no regular sleeping time, but dropped down for a few minutes now and then when they had respite. Thirty-six said their sleep was poor, nothing like so restful as at night; others rated it as fair or good. Several laughed when asked if they slept well, asserting they could sleep at any time in any spot. One competent-looking Englishwoman, a former Lancashire weaver, answered: "Sleep! Well, rather! I could sleep on a pin-point or pegged out on a line."

The hours of sleep of unmarried night-workers were much better than those quoted for the married. Of seventy-six answering only thirteen had less than seven hours' sleep, and fifty had over eight hours. Only five suffered the disadvantage of broken rest, interrupted by household cares. Only six complained of poor sleep. Even these care-free young women complained, however, that their rest was broken in summer, when windows are open and children out of school are screaming on the streets, hucksters calling and automobiles honking.

One mill owner, an enthusiast for night-work, differed from the generally accepted standard of eight hours' sleep, maintaining that no one needed more than six. "If he takes more, mark my word, he lacks ambition. He is a follower, not a leader." As for himself, he had not taken more than six hours in twenty years. The inference was obvious. The effect of these energetic sentiments was somewhat marred, however, by the prodigious yawns which broke in upon them now and again.

Another mill man said of the appallingly small amount of sleep his women workers were getting: "Oh, well, they make it up at the end of the week. You see, they don't work Saturday or Sunday nights, and there is a good long stretch for them to sleep." Of course during that period of leisure a hungry husband and hungry children still want three meals a day. A big, hard washing has to be done in this same leisure—many women giving as one advantage of night-work the opportunity to do family washing. Sunday, as women not night-workers realize, seems to be a day when appetites, normally large, expand to terrific proportions and food disappears by magic. Mending and sewing must be done in spare moments, and always babies demand attention. In short, the idea of the average married woman night-worker, with a family, making up quantities of sleep at the week-end is a myth comfortable for employers, but not rest-giving to the worker. Furthermore, it has been found by scientific experiments (20) that sleep lost one night is not easily made up, and that the system shows unmistakable signs of the loss for days.

Conditions of Sleep.—Naturally the great majority of the women visited lived in poor districts of the city, where sanitary arrangements are most elementary. When the worker, cruelly tired from ten hours' work, comes home in the early morning, she usually scrambles together breakfast for the family. Eating little or nothing herself and that hastily, she tumbles into bed—not an immaculate bed in an airy bedroom with dark shades, but one still warm from its night occupants, in a stuffy little bedroom, darkened imperfectly, if at all. After sleeping exhaustedly for an hour, perhaps, she bestirs herself to get children off to school, or care for insistent little ones, too young to appreciate that mother is tired out and must sleep. Perhaps later in the forenoon she again drops into a fitful sleep, or she may have to wait until after dinner. There is the midday meal to get and, if her husband cannot come home, his dinner pail to pack with a hot lunch to be sent or carried to him. If he is not at home, the lunch is rather a makeshift. The midday meal is scarcely over before supper must be thought of. This often has to be eaten hurriedly before the family are ready, for

the mother must be in the mill at work by 6, 6.30 or 7 P. M. There must be time enough to get the machines set up before the regular hour for beginning work. Many women in their inadequate English summed up their daily routine by, "Oh, me all time tired. Too much work, too much baby, too little sleep."

Only sixteen of the 166 married women were without children; thirty-two had three or more; twenty had children one year old or under. There were 160 children under school age, below six years, and 246 of school age.

A woman in ordinary circumstances with a husband and three children, if she does her own work, feels that her hands are full. How these mill-workers, many of them frail looking, and many with confessedly poor health can ever do two jobs is a mystery, when they are seen in their homes dragging about pale, hollow-eyed and listless, often needlessly sharp and impatient with the children. These children are not only not mothered, never cherished, they are nagged and buffeted. The mothers are not superwomen, and like all human beings, they have a certain amount of strength, and when that breaks their nerves suffer.

The Day's Routine.—The following are concrete illustrations of the existence of night-workers:

A social service visitor from the Rhode Island hospital called on an Italian woman to see her little 4-year-old girl who was suffering from a tuberculous hip. When a rosy cheeked young woman came to the door, the visitor was struck with her appearance of exuberant health. It was hard to believe that this youthful person was 33 years old and the mother of six children. The visitor called again when the mother had been working at night steadily for five weeks in a textile mill. She could hardly believe that the pale, listless, unkempt woman who greeted her was the same whom she had seen before. The schedule of this mother's life for the past five weeks ran as follows: Coming in from work, she hurriedly got a simple breakfast for the family, swallowed a little herself, and was in bed by 5.30 or 5.45. In two hours or a little over, she was up again to get the children off to school. By that time two little ones, a 3-year-old baby and the little sick child, 4 years old, were needing her care. Then followed sweeping and cooking. Dinner must be ready soon after 12 for husband and children. In the afternoon she was on her feet almost every minute doing only the absolutely necessary work. Supper had to be left ready for the family after her own had been hurriedly eaten alone. She must be at work in the mill at 6. Her ten-hour night, hard for anyone, was particularly hard for her, because of her inexperience and her laborious day. A month of this kind would transform almost anyone.

Mrs. E., an Austrian Pole, 26 years old, had been working at night for a year. Her family consisted of husband and one baby, 2½ years old. Three children had died. She looked thin and worn and said she never felt well. In the morning, her sleep was less than two hours and in the afternoon never more than two. "My baby is a little rascal," she said, "he never will let his mother sleep. All the time he must have his mother, or else he cries and cries."

Mrs. G., a Pole, 38 years old, whose worn, furrowed face made her look at least 50, had been working at night for two years. Asked why, holding a six months' baby in her arms, she pointed to five small children swarming about her, and said laconically, "Too much children." She added that there had been two more, but they had died. When asked why they had died, she shrugged her shoulders and answered listlessly, "Don't know." Her day's work would sap the energy of any ordinary person. She got home soon after 4 in the morning, cooked breakfast for the family and ate hastily herself. At 4.30 she was in bed, staying there till 8. But part of that time she was disturbed, for the children were noisy and the tenement was a tiny, dingy place in a basement. At 8 she started the three oldest boys to school and cleaned up the debris of breakfast and of supper the night before. At 12 she carried a hot lunch to her husband, and had dinner ready for the three school children. In the afternoon there were again dishes and cooking, and caring for three babies, aged 5 and 3 years and 6 months. At 5 supper was ready for the family. The mother ate by herself and was off to work at 5.45.

Mrs. H., a frail-looking Frenchwoman, 27 years old, has a husband and five children ranging from 8 years to 14 months. Three other children had died. When visited the day was unbearably hot and the little woman was doing a big washing. "No, I don't like night-work, for it means working day and night, but I should hate to see it go, for what would I do? We have all been sick and owe $50 for groceries." Asked how long she slept in the day, she pointed to the little army of children—"Well, how much do you think with that going on?" She estimated that, perhaps, counting the two or three different naps snatched here and there, it might be five hours "such as it was." "I take my baby (14 months) to bed with me, but it cries, and my little 4-year-old boy cries too, and comes in to make me get up, so you can't call that very good sleep."

From these illustrations it appears that there is a pitifully meagre amount of sleep, and that little often non-continuous. Many married women who had had so little rest by day, used their lunch hour in the mill for sleeping. With a roll of waste under their heads for a pillow they stretched out on the bare floor and dropped into the sleep of exhaustion. Naturally many caught bad colds.

The problem among unmarried women or those without family is not the same. They sleep longer by day than they normally would at night. For obvious rea-

sons, however, their day sleep cannot refresh them as a shorter period at night would do. They lose in other ways by night-work, as appears later.

Irregular Eating.—Next to normal night sleep, well-cooked, nourishing food eaten regularly contributes most to general good health. Many women ate no breakfast when they came in from work because they were too tired. When they tried to, they suffered from indigestion, for being overtired, they could not assimilate the food which had been hurriedly and unappetizingly prepared. Many merely drank tea or coffee. Often the husband did not come home for dinner and there was a hastily cooked, inadequate meal for mother and children. Frequently the wife had to eat supper hurriedly alone, before the family, to get to work on time. She generally carried a light lunch for the night—for it was exceptional when a midnight meal was served at the factory—and this she often ate while working, so as to use the lunch hour for precious sleep. The day-worker almost always has an hour at noon to go out into the sunlight and air away from the factory.

Of the 246 women night-workers visited, fifty-two had an hour for lunch, a much larger proportion than for the state as a whole, because these people were largely employees of a particularly well-conducted mill; twenty-three had no lunch time; ninety-four had a half hour; and the others a varying length of time. For the twenty-three who worked straight through the night, the strain was inexcusably hard. Three-quarters of an hour should of course be the minimum time. A half hour is too short either to rest or to eat properly. No law prescribes the time allowed for meals.

Eye-Strain.—No physical tests were given the Rhode Island women and therefore no accurate information about their health is available. Many looked ill, and fifty-two described their general health as poor. One of the common complaints was headache, due doubtless in part to eye-strain, for most of the work demanded close attention. A few women protected their eyes with colored shades.

In many mills, the lighting was poor in quality or location. Even in the few plants where a scientific study of lighting has been made, it is inevitable that eyes which have any tendency to weakness suffer from ten hours' work by artificial light, particularly if the person comes imperfectly rested from day sleep.

Expectant Mothers. — The expectant mother in the mill is often a problem to the employer, for she is reluctant to leave when for obvious reasons her being there is injurious both to herself and her work. Discharged from the day shift, she sometimes reappears on the night force, and *vice versa*. A woman day supervisor in a large mill tried to induce women to leave after six months' pregnancy, but again and again met with opposition. Often it is left with the bosses to dismiss them. Many women told of working up to within a few weeks of the birth of their children, and of returning in a perilously short time afterwards.

Specialized medical knowledge is not needed to realize that factory work under any circumstances is bad for a woman far advanced in pregnancy. Particularly night-work, after altogether insufficient rest at home during the day, is a terrific strain.

Mrs. D., who had been working a little over three months, had a baby, two months old. She had worked right up to the baby's birth and had returned in three weeks.

A woman supervisor told of receiving word one morning that a girl was ill. The doctor, promptly sent for, arrived with an automobile just in time to carry the woman home and to save the child from being born in the workroom. "It's queer," this informant continued, "but some women, both on the day and the night shift, will stick to their work right up to the last minute and will use every means to deceive you about their condition. I go around and talk to them, but make little impression. We have had several narrow escapes, but that was the closest."

Working in Bad Air.—The ventilation of the mills visited was by no means generally satisfactory even by day when conditions are most favorable; at night the atmosphere was often unbearable. Apparently between shifts there had been no thorough airing of the rooms. Also unpleasantly often, in the vicinity of the toilets, there was a noticeably disagreeable odor. In few factories were there separate cloak rooms or even wardrobes, and street clothes of men and women, hang-

ing on pegs in the workroom, added to the general closeness. To increase the discomfort, the rooms were often very hot; in a few instances, necessarily so, owing to the nature of the work. To the investigators it seemed a marvel that in these hot, close rooms the listless women could work the night through without fainting at their machines. An educated girl, who worked for a time at night as a patriotic duty, said that production noticeably fell off as the air became more and more vitiated. Humidity, necessary in some processes, but unregulated by law, further saps vitality.

Catching Cold.—Many workers had caught bad colds by going out with dampened clothing from the humid, fetid air of the workroom. "We felt as if we should suffocate if we didn't get outside a minute. We were too tired to bother with wraps." Outer clothing, often dampened from hanging in the workroom, added to the women's susceptibility to colds when tired out with night-work.

Lack of Seats.—In the state as a whole, there is a prevalent lack of seating of any kind, though stools and chairs (sometimes with backs) are supplied in some mills. One superintendent reassured the investigator, "Now, don't worry about that! I know these help better than you do, and if they want anything they make it known. They haven't mentioned seats, so I guess they're satisfied. Don't think they stand all the time. They always find something to sit on."

That was just the trouble—women were sitting crouched uncomfortably on a waste box, on a little low "cricket" or any makeshift. Sometimes they sat on the floor, propped against the machines, or bowed over, their faces in their hands. One boss, even though accustomed to these sights, was moved to remark, "Poor things, I suppose the children don't let them sleep much in the daytime. They have to be stirred up occasionally."

Vibration of Machinery, Monotony of Work, etc.—Because they are not rested sufficiently from the fatigue of the night before, women suffer unduly from general causes; continual vibration and noise of heavy machinery; dust and impurities in the air; in some processes continuous standing; and the speed and monotony of their work. The monotony of a process once learned is deadening to the spirit, for automatic machinery demands no ingenuity from the worker.

Provisions for Comfort and Safety.—In some mills, the night shift put on to meet the war emergency was regarded as transient; naturally, then, provisions for safety and comfort had been less carefully made than for the day shift. In the few factories where a nurse was on duty by day, there was none at night, and the exceedingly rare hospital was closed at night. "Someone" had the key, but vagueness enshrouded this person. No one knew how in an emergency the key could be reached quickly. Even first-aid equipment was frequently rudimentary and kept inconveniently distant from the workroom in a drawer or closet of the office.

From industrial statistics (21) it is learned that more accidents happen at night than by day. Whether this is true of Rhode Island factories cannot be shown, for want of local official statistics. It is, however, undeniable that with inevitably harder conditions of work at night, with artificial lighting and greater fatigue, equal provision against illness and accident is needed for night and for day workers.

Supervision at night is much less thorough and skilled than by day. Often the bosses, not understanding the language of the workers, and with no first-aid training, are entirely unfit to meet the emergency of an accident among tired, inexperienced women. Some employers intimated that if they afforded the same supervision and privileges by night for the fewer employees as for the larger force by day, night-work would yield too little profit to warrant its continuance.

NIGHT-WORK CAUSES NEGLECT OF CHILDREN

In 1916, New England, New York, Maryland, Michigan, Minnesota, the District of Columbia, and Pennsylvania were chosen by the Federal Census Bureau (22) as a "registration area" in which to study infant mortality. In this territory as a whole the rate of infant deaths was 101 per 1000 births; in Rhode Island, it was 111. Of twenty-two cities of more than 100,000 inhabitants, fifteen showed a smaller percentage of infant deaths than Providence where the rate was 110 per thousand. Rhode Island having the highest proportion of women in industry

among all the states in the Union, the relation between the high infant mortality rate and the large number of working mothers seems obvious. How it is affected by the night-work of mothers is not shown by official data.

The reason most frequently given by married women for working at night is the necessity of being with their children by day. The father can care for them in the evening and at night, or an older child, a boarder or a neighbor. In 108 of 164 families visited, fathers assumed the responsibility and sometimes children (often babies) were left alone in the unavoidable gap between the departure of one parent and the arrival of the other. Frequently the father would not stick to his post the whole evening but would leave the lonely house and sleeping children to seek company elsewhere.

A well-known social worker, a nurse who by her position has unusual knowledge of conditions, said the worst consequences of a mother's working at night do not fall upon her—serious as they are—but upon the older children left to their own devices. Girls have come under her care whose irreparable injury was traceable to the mother's absence at night. One girl of 12 years was, according to trustworthy neighbors, receiving men in her home in the evening after her mother had gone to work, and the nurse was in daily expectation of receiving the child as a patient.

In addition to intangible injury to children from the mother's absence, gruesome effects were apparent in the gaps in ages in families of children. When asked to explain the untimely deaths of these little ones, mothers despairingly answered, "Don't know—very sick and died so quick."

A Polish woman with seven children had been working at night for four years. Her two daughters, aged 19 and 17, also worked at night. Consequently the five younger children, ranging from 12 to 5 years were pitifully neglected, not only at night when, as the mother said vaguely, a boarder, or neighbor, or "someone" looked after them, but quite as much by day when she could take no motherly interest in them. In the late afternoon the two daughters still in bed in a filthy dark bedroom, shouted bits of information or jeered at their mother's reference to her "brother," who boarding there, tenderly cared for the children in her absence. "Brother! How long since has he been your brother?" In this family, a 12-year-old girl is a cripple and when she visited the hospital for treatment, her body was in so revolting a condition, the nurses rebelled and sent word to the mother that they could not treat the child unless she was more cleanly.

An Italian, 18 years old, put her 6-months' old baby in the care of a neighbor whom she paid $3 a week. The baby soon died of tuberculosis, and the attending physician said the death was due solely to the mother's neglect. She had weaned it on starting to work, and with new food and change in care-takers, the little thing lacked the vitality to survive.

A Polish mother with five children had worked in the mill either by day or by night ever since her marriage, stopping only to have her babies. One little girl had died several years ago, and the youngest child did not look promising. It had none of the charm of babyhood, its body and clothing were filthy, and its lower lip and chin covered with repulsive black sores.

Another mother had worked at night for nine months to supplement the insufficient allotment of her husband away at camp. Mrs. L. was soothing in her arms the baby which as it lay wrapped up, looked 3 or 4 weeks old; but as the mother turned to show the child, it was hard to check an exclamation of distress. The little creature was a year old but weighed less than when it was born. It had been at a hospital for two months, "but they don't know what the trouble is." It had been failing steadily since coming home. A year ago her 2-year-old baby had died—"something was the matter with its head."

Of course these mothers, working at night, are unable to take advantages of any opportunities for self-improvement, lectures, concerts, evening schools. A shockingly large number of young mothers, bringing up children in American communities, were unable either to speak or to understand English. For their own safety (23) in the mills, such knowledge should be compulsory. It is commonly known that many injuries result from such ignorance. Warnings spoken or printed are alike lost on people who neither read nor

understand English. In a larger view, it is essential that these keepers of the home should be more adequately equipped for their duties as parents. With their present impossible scheme of life, they have neither time nor strength for the slightest effort toward self-improvement. Their work at the mill depends so fully on machines, and requires so little intelligence, that there is no mental stimulus from it. The monotonous repetition becomes stupifying.

UNMARRIED WOMEN NIGHT-WORKERS

Most of the eighty unmarried women who worked at night were young; fifty-seven being under 24 years, and eighteen less than 17 years old. More than half were less than 21 years old. While they suffer less than the married women from loss of sleep, the demoralizing effect of night-work on them is much more serious. It is obvious that young girls are in greater peril from defective supervision, inadequate lighting in factories, and the necessity for being on the street at unseasonable hours, than are older married women. Many mothers will not allow their daughters to run the risk involved in night-work, remarking, "It isn't good for a young girl."

Several girls objected to the necessity of "keeping in" with the boss or reaping the consequences in unfair treatment. A less serious evil is the obscene talk many women are forced to hear, which could be controlled by proper supervision. Several employers agreed that among night-workers there is greater exhaustion, which lessens their self-control. The women added that there are more opportunities for wrong-doing in a mill at night because of imperfect light and woeful lack of supervision. In only two factories was there a woman supervisor at night. In many the bosses were young, inexperienced and unable to understand the language of most of the women. Usually the night superintendent went through the mill only once or twice, and as the women often worked at some distance from one another, it was easy for an evil-minded foreman to make himself offensive. A nurse in a large hospital told of two cases of assault resulting from this combination of circumstances. Other outrages were related by workers.

WELFARE, COMFORT AND EFFICIENCY OF WORKERS

Provisions for welfare, comfort and efficiency of workers in textile mills in Pennsylvania and New Jersey were described in some detail in Section 1 of this study. They were little better in Rhode Island. Workers in that state are, moreover, less protected because of the unique feebleness of the labor law (24), which leaves to the factory inspectors the decision whether or not dressing rooms for women shall be afforded, whether heating (25), lighting, ventilation or sanitary arrangements are injurious, whether fire exits are sufficient and machinery properly guarded. Yet no factory inspector in the state of Rhode Island has ever been a heating, lighting or ventilating engineer, or an expert in any branch of enforcement of the labor law. Even a zealous enforcing official, however technically competent, would find in the present law no objective standard to support his mere opinion.

The following summarizes conditions in thirty-nine textile mills visited and throws additional light on the exhaustion of the night-workers:

Cloakrooms or Dressing Rooms.—The inevitable results of leaving the installation of dressing rooms for women to the discretion of factory inspectors were that only eight of the thirty-nine establishments had such facilities, and of these two could be so called merely by courtesy. Two large mills had, instead of cloakrooms, wooden and steel lockers in passageways and along the walls. In the others, street clothing was hung on pegs and machines in the workroom. If a woman wished to change her clothes, she had to do so in full view of other workers, men and women. After the clothing had hung all night in the excessive moisture common to textile mills, it was often unfit to wear out into the sharp morning air and proved a prolific source of colds. In occupations in which the rate of tuberculosis is admittedly high, risks of this sort should not be inflicted upon the workers.

Rest Rooms.—Only one mill had a room equipped and furnished as a comfortable rest room. Two others had little ill-kept rooms, thus misnamed, where a few stiff chairs only were provided.

Lunch Room.—In spite of the dust com-

mon to textile processes, only two mills set apart a room where lunch brought from home might be eaten; two mills had restaurants, but one had no night shift, and the other only a small one. A third place in an inaccessible location served a hot meal at noon, but only hot and cold drinks at night, and inadequate facilities made even this process long and wearing.

Hospitals.—Five of the mills visited had well-equipped hospitals with a nurse in attendance by day, but not at night. The others were content either with no first-aid equipment or with the meagerest amount.

Washing Facilities.—These were generally poor, hot water being rare and soap and towels non-existent. In a few mills only was it possible for the women to wash in the privacy of a separate room. The usual place was long sinks in the workroom. Most workers have entirely inadequate means of cleanliness in their homes, and in the mills it is impossible to rid oneself of the grime of work without hot water, soap and towels. Liquid soap and paper towels are now within the reach of any establishment, and cleanliness plays so large a part in the health and efficiency of workers that it is only good business to make it easy and possible. Employers excuse themselves because employees do not co-operate. But supervision and directions would go far in this respect.

Guarding and Cleaning of Machinery.—Much machinery was, according to modern standards, inadequately guarded and badly spaced. The law is indefinite (25): "If the factory inspectors find that belting, shafting, gearing, elevators, drums and machinery in shops and factories are located so as to be dangerous to employees, and not sufficiently guarded—they shall notify the proprietor of such factory to make the necessary alterations or additions within ninety days. . . . ."

Seats.—Here again the law is vague (25): "In every manufacturing, mechanical or mercantile establishment in which women or boys are employed, there shall be provided, conveniently located, seats for women . . . and they shall be permitted to use them while their duties do not require standing." Textile processes require standing from 60 to 75 per cent. of the time the operatives are in the mill, and more adequate seating, and accommodations for rest are urgently needed.

Cleanliness and Upkeep.—While three woolen mills, and nine cotton mills were clean, well-kept and modern, others were old, dark, and unclean. In several woolen mills festoons of dirty wool hung from the rafters and the floors were cluttered with waste. A finishing plant had a low standard of cleanliness. In the starching and tentering room, the uneven places of the cement floor were filled with starchy overflow, and the roof leaked badly. A small thread mill occupied part of an old brick building. Its attic workroom with wooden rafters and dirty slippery floors, mended in various places, was dark and untidy. The whole place was a firetrap, and the manager regretfully admitted he had a bad-looking mill. A silk plant was equally dirty and ill-kept, with rotting floors, unwashed windows, narrow entries, and decrepit stairways.

In cotton mills recently remodeled, or newly constructed, much attention was paid to ventilation, lighting, spacing of machinery and other mechanical details, but provisions affecting more intimately the comfort and well being of the workers, dressing rooms, rest and lunch rooms were conspicuously lacking.

REVISE THE SANITARY LAW

It must be obvious from the foregoing summary of conditions in thirty-nine Rhode Island mills that the sanitary law regulating factories should deprive factory inspectors of discretionary power and should specifically require the following elementary provisions for the comfort and safety of workers:

1. Adequate dressing rooms for women and girls.
2. A lunch period of one hour both for day and night shifts (while the latter last).
3. Seats, definite in number and kind, and exclusion of the present makeshifts, boxes, stools and crickets.
4. Rest rooms, with couches and comfortable chairs, lunch rooms and restaurants. Eating in workrooms should be forbidden.
5. Specific and modern requirements

for guarding and cleaning machinery.

6. Regulation of humidity in workrooms.
7. Accessible modern first-aid equipment.
8. Women supervisors, both by day and night (while night-work lasts).

Night-work by women and girls employed in manufacture has, even when it was legal, been a confession of incompetent management since 1910. In that year fourteen European nations had legislated to abolish night-work, having ratified a treaty for that purpose, first agreed to in 1906. In 1914, the Court of Appeals of New York upheld the state law of 1913, forbidding employment of women between 10 P. M. and 5 A. M. The Court reversed, for the purpose its decision of 1907 in which it held such a prohibition contrary to the constitutions of New York and of the United States.

Yet, both in war time and since the armistice, Rhode Island and New Jersey have permitted that waste of women's health and industrial productive power which the civilized world has thus officially condemned. In 1919, for the fourth time, Rhode Island killed a far from drastic night-work law for women. It is hoped that the facts brought to light in this survey, coming at the present moment of extraordinary awakening, may afford fresh stimulus to public interest in meeting this urgent need of wage-earning women.

SUMMARY OF CONCLUSIONS

The conclusions of this enquiry are briefly:

1. The textile industry in the establishments visited is as belated and unstandardized as were the erstwhile sweated needle trades.

2. Long hours, dangerous and unguarded machinery, neglect of the elementary principles of hygiene, a wage scale for men notoriously so low that wives and children have always been drawn into the mills—these are as characteristic of the textile industry as they formerly were of the needle trades.

3. The one safeguarded picker and the three clean picker rooms, the rare dustless carding rooms and the four Pennsylvania factories which obeyed the law throughout—these examples show that the prevailing conditions are not inevitable.

4. Closely interlocked with the making of woolen cloth is the filthy shoddy industry, which degrades and endangers the workers.

5. In the three states in which our observations were made, labor organization in the textiles is rudimentary. It has always been opposed and, so far as possible, suppressed by employers who themselves are powerfully organized. The women wage earners employed in them have, therefore, missed all the experience of self-education and of sanitary improvement in their surroundings while at work, achieved in recent years by their fellows in the needle trades.

RECOMMENDATIONS

During the preparation of this article Massachusetts, the greatest textile manufacturing state in the Union, has for the fourth time set by statute a new high standard for the health of the wage earners. In 1876, it confirmed by a decision of its Supreme Court, the ten-hour day for women in manufacture. In 1907, Massachusetts forbade women to work in textile mills after 6 P. M. and before 6 A. M. In 1913, a minimum wage commission was created. In 1919, the forty-eight-hour week for women in manufacture was established by law. In taking three of these four steps, the state led all others in the country.

1. To bring the textiles in the states covered by the present study up to the standard now in force in Massachusetts, the legislation necessary for women in 1920 includes:

  a. Prohibition of night-work in Rhode Island and New Jersey.
  b. A forty-eight-hour law in Pennsylvania, Rhode Island and New Jersey.
  c. Establishment of minimum wage commissions in these three states.
  d. Strengthening and enforcement of the sanitary laws.

2. In the interest of the public health, an honest cloth bill should be passed by Congress.

3. To control the present chaotic rag industry, municipal rag shops should be established, and disinfection of all rags before they are otherwise handled made compulsory.

In carrying through this program, reliance must be placed on an increasingly exacting public opinion. There is ground for hope that the new voters will, as soon as the federal amendment is ratified, devote their freed energies to standardizing this socially belated industry. The public attention given to the formerly sweated needle trades should now be concentrated on the textiles. The needle trades are so well organized and so well officered, relations between manufacturers and workers in them are, therefore, relatively so cooperative and enlightened, and public opinion is so alert on the general subject, that the task of to-day is to bring the textile industries up to the present level of those once sweated trades.

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THE RELATION OF DRUG ADDICTION TO INDUSTRY *

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THE Secretary of the Treasury authorized a survey of the nation relative to the narcotic drug situation, and a commission consisting of Hon. B. C. Keith, Deputy Commissioner of Internal Revenue; Prof. Reid Hunt, Harvard Medical School; Dr. A. G. Du Mez, U. S. Public Health Service; Lieut.-Col. Pearce Bailey, U. S. Army Medical Corps, and Hon. H. T. Rainey, Representative from Illinois, was appointed. A full report is not yet available,† but newspaper reports attributed to Mr. Rainey are to the effect that the estimated number of drug victims in the United States is about 1,000,000 and rapidly growing; that drug addicts spend approximately $61,000,000 a year for their narcotics; and that native-born Americans are most prone to the habit. More or less alarmist reports are given relative to the large cities, including New York, Philadelphia, Pittsburgh and Jacksonville. A further newspaper note is to the effect that the report is undergoing verification before it is published in detail.

Dr. Copeland, Health Commissioner, New York City, is stated to contend that there are between 100,000 and 200,000 drug addicts in that city and that Philadelphia is, relatively to population, not far behind. Sweeping generalizations are easily made. For instance, Frederick L. Hoffman, in his pamphlet, *Army Anthropometry and Medical Rejection Statistics*, cites the hypothetically assumed opinion of Dr. J. H. Quayle, of Cleveland, Ohio, that 296,640 recruits out of 9,000,000 available under the selective service system would be rejected from alcoholism.

The *Second Report of the Provost Marshal General*, on the selective service system, showed that out of a total of 467,694 rejections and discharges, 2,007 were for alcohol and drug addiction. Drug addicts were detected, generally, after acceptance; they were placed in "Group B"—those having defects regarded as remediable—and the condition was not found to be as prevalent as many have supposed. Out of 556 drug addicts studied, teamsters, drivers and chauffeurs constituted 12.8 per cent.; laborers, 11.7 per cent.; waiters and hotel servants, 8 per cent.; bookkeepers and office assistants, 7 per cent.; the rest were divided among many classes of workers.

Despite the effort recently made in New York City, Dr. S. Dana Hubbard of the Department of Health and in charge of the Narcotic Relief Station, reported, according to *New York Medical Journal*, May 3, 1919, on 1,506 patients admitted. This number, of course, represents only a part of the total number of addicts in New York City; but it shows fairly definitely that the figures of Dr. Copeland were excessive and that there are not 100,000 drug addicts in that city.‡

The federal and city authorities in Philadelphia, in co-operation with the state bureau with which I am connected, have earnestly studied the situation there. We have detailed monthly reports available from drug stores, physicians' offices, various inspectors and police officers, and we keep a card record of addicts. Under a very rigid state law, these reports must come into my office. Doubtless much data is concealed from us, but our own rather intensive survey does not reveal over 1,500 cases of pure addiction in Philadelphia and we do not actually have that number registered, as required by law. I do not know of more than ten drug stores in that city which we are obliged to supervise regularly. In fact, the reports from the Philadelphia drug stores are among the cleanest in Pennsylvania.

We do not class as pure addicts persons who have definitely ascertained disease justifying the attending physicians in administering narcotics to them more or less regularly. If we consider such persons as addicts, the estimate of 1,500 drug addicts must be largely increased, for there are many patients with cancer or

*Received for publication June 12, 1919.

†Officially issued after this article was written and before it was published.

‡About 9000 addicts were registered under the law which has gone into effect since the above was written. Probably one-fourth or one third are registered to date.

other malignant disease, with post-operative conditions, with aggravated types of asthma and cardiac dyspnea, with excessively painful conditions, or with incurable disease with aggravated symptoms, etc., who become addicts in a certain sense. And we can probably subtract 500 aged persons who have taken narcotics for from twenty to forty years, who are no menace to the community, and from whom it is impossible wholly to take the drug of addiction. So then, as nearly as we can ascertain, our problem in Philadelphia is narrowed down to about 1,000 persons.

In the South conditions are aggravated —some authorities say on account of state prohibition—and yet a careful survey in Jacksonville resulted in the registration of only 101 drug addicts. I, personally, know conditions in Jacksonville and am of the opinion that there are, besides, a large number of drug tipplers who use drugs, principally cocaine, when they can get them, and do without a large part of the time. And yet, taking as unpromising a class of persons as the inmates of hospitals for the insane in North Carolina, according to *Charlotte Medical Journal*, April, 1919, for every eighty-four patients admitted to the state asylums only one is a drug addict; in Georgia two would be drug addicts, while in Mississippi the reports are that a yet greater proportion are addicted to drugs.

Realizing fully the great incidence of drug addiction, it is nevertheless necessary to secure reliable statistics before one is justified in generalizing widely. Such statistics are available only from a few sections and classes and, though many sweeping assertions have been made, there are practically no statistics as regards drug addiction in the industries.

The fragmentary statistics gathered as regards addiction among industrial workers nearly all parallel rather closely those noted in the army; that is, it is the unskilled worker who is the more prone to addiction. Among women, as is to be expected, prostitutes rank highest, and then follow the unskilled workers. Various classes of domestic servants figure rather largely in the reports.

The professional classes, both men and women, figure rather largely in our reports in Pennsylvania—chiefly physicians and nurses, followed by dentists, clergymen, lawyers, writers and others. Among business people, executives under strain contribute the larger proportion; but business people in general do not seem given to the use of narcotics. The idle wealthy class contributes heavily to the lists, as do the idle and shiftless elements in all classes of people. The overworked, more especially those working at night and resting by day, are prone to drug tippling but are seldom confirmed addicts. The normal man or woman under normal or favorable industrial conditions is little given to drug addiction. Bad industrial and housing conditions favor intemperance and drug addiction. We have especially noted this fact in the coal mining sections of Pennsylvania.

Aside from vicious surroundings and industrial hardship, the one factor that stands out prominently in the data we are collecting is the factor of inadequate and incompetent medical and dental care. I have had unusual opportunities to study medical conditions throughout the larger portion of the Union; and we must face the fact that the average worker and his family do *not* receive either adequate or properly balanced medical attention. The advocates of so-called health insurance have presented a wealth of data covering this factor in general, but they have not brought out the fact, which our Pennsylvania reports make daily more apparent, namely, that drug addiction has as its largest contributing cause unwise, ignorant and careless medical attention.

Compensation statistics and reports, so far as they have been collected, bear this out in other directions. The weak factor in compensation insurance today is not the laws themselves so much as the fact that commercialized carriers and commercialized physicians are too prominent therein. When this defect is remedied by having the state carry the risks, and by excluding entirely commercial insurance companies, the medical, surgical, nursing and hospital services will be placed on a proper fee basis and only skilled services will be accepted as adequate in compensation work. Until the health insurance advocates realize this condition and provide fully in their program for its correction, the same personnel which now gives poor medical service to the industrial worker

will be continued and its defects will remain as they are or may even be exaggerated.

The sum total of human misery due to lack of or to incompetent medical and surgical attention is a thing little realized. Literally thousands of persons who contract illnesses, which under proper care are readily curable, become chronic sufferers or even incurables under the care they actually get. Such persons often drift into more or less permanent drug addiction. About one-half of the addicts reported to the Pennsylvania bureau are addicts because of disease. I am not speaking from any assumption or generalization, but on the concrete evidence of our card index of named persons who are addicts. Direct investigation of many of these persons reveals the fact that the addiction has become a more tangible factor in their incapacity than is the disease leading to the addiction. Until after the medical personnel caring for the workers in industrial pursuits becomes what it should be, this condition will not be remedied. Industrial physicians employed by large concerns are doing a grade of work so far in advance of the average rendered in industrial communities that it is becoming more and more apparent that the state must organize in such fashion that all industrial workers shall receive the benefit of the same grade of service when sick or injured. Call it health insurance or some better name, conduct it by a panel system or some more efficient plan. The point is this: it is the personnel that counts, not the mere program or administrative scheme.

While drug addiction may or may not count for much on the pay roll list, it does count very largely on the disability roll and among the families of the workers; and, if skilled and adequate medical and surgical care is provided for all of the workers and their dependents, this disability roll will be materially shortened and the morbidity and mortality reports of industrial communities will be markedly improved.

Another factor is this: medicine as it is taught and as it is practised are two vastly different things. No one realized this more acutely than the thousands of medical practitioners who entered the government services during the war, for the majority of them were required to drop their old methods and administer to the soldier patients according to the tenets of modern medicine, which was good for the patients and especially good for the new medical officers.

As regards the use of narcotics in medical practice, the reports we receive in the Pennsylvania bureau covering purchases of narcotics by physicians and prescriptions filled by pharmacists show without dispute that the rank and file of medical practitioners in the state are employing narcotics vastly in excess of what the standard text-books teach to be justified in legitimate therapeutics. I am not referring to physicians who cater to drug addicts, but to the average hard-working physician. He gets into a rut and comes to prescribing narcotics under a host of trifling indications. I was assigned to epidemic work in five states during the recent scourge of influenza, and everywhere the physicians, or most of them, made wholesale use of codeine, heroin and even morphine; and the places where this practice was all but universal were the industrial communities, where medical fees are low and where the pop-call method is most in evidence in the physicians' rounds.

So far as our findings in Pennsylvania are concerned, the free prescribing of narcotics in ordinary medical and surgical cases is one of the main etiological factors in the production of drug addiction. The survey we have made, and are still making, shows very definitely that there are three classes of communities or neighborhoods where free narcotic prescribing prevails most largely, *viz.*, in the vice districts, in the sections where the wealthy reside, and in the industrial communities where no industrial medical service is furnished. There is, of course, a class of debased physicians who make a business of catering to drug addiction, and they are found in the three classes of communities noted. Like the abortionist, they are there because there is a demand for them—a demand too often the result of the fact that incompetent physicians have started a large number of drug addicts, refuse to prescribe after the addiction becomes confirmed, and leave the victims of poor therapeutics to resort to the man who makes a business of supplying them with drugs.

This vicious circle leads to another fac-

tor in the industrial situation—a factor which few industrial physicians realize but which is very apparent in the records of this bureau—namely, there are a great many more or less efficient workmen who cannot continue in their employment unless they have a regular supply of the drug to which they are addicted. Some of these people are very reputable citizens, keep the dosage down as low as they possibly can, lead otherwise correct lives, support their families, render fairly efficient service to their employers, often make a sincere effort to drop the habit—usually during vacation—and yet they are addicts and gradually depreciate in efficiency. Most of them are not recognized as addicts, and when they get to the point where the drug is gaining the mastery they drift away from the place of employment to some other, where they work at less responsible employment, and so on, down, down, down. The names of many such go through this office, and these cases are sad. I know of twelve such men in one small industrial community in northern Pennsylvania, yet under the law I dare not report them except to the physician who is making an effort to cure them of the addiction by gradual reduction.

There are many women working in stores and offices or in domestic employment who spend half of their wages to buy narcotics and who yet despise themselves for it. They work hard and try to be respectable, but the time comes when wages will not reach; they *must* have the drug, and they have to pay large prices to the peddler who grafts on them, so they forge small prescriptions on physicians who write carelessly, or they get a "friend" who has ways of his own, and they drift on and on, usually into prostitution, open or secret. Some of these women, even from distant parts of the state, come to see me, and between sobs tell their stories. Many of them are really ill, aside from the addiction, and theirs is a hard lot generally.

Ernest S. Bishop, who has added much to our understanding of drug addiction, contends that the continuous administration of opiates establishes in the body a reaction of protection against toxic effect, and that the addiction thus produced is a form of physical disease or a disease mechanism. He contends, also, that the average narcotic addict wants to be cured in order to get away from a physical hell. He does not grade addicts appreciably and a logical deduction from his teaching is, that continued taking of opiates for any length of time will almost invariably lead to this disease mechanism.

The neurologists, on the other hand, believe that drug addiction has a particular tendency to attack the neurotic and that addiction is largely a psychosis, is not altogether a physical disease, but involves psychiatrical problems as well.

Addicts contend that giving a narcotic drug for a month continuously establishes an addiction. This is a fair inference from the experience of the individual who readily becomes an addict, but any physician of experience knows that many persons, more especially those who are ill of a disease justifying the use of a narcotic, may take opiates for much longer than a month and not become addicts.

In this bureau we keep a record of all heavy narcotic prescriptions appearing on the reports of more than 2000 druggists. Many hundreds of names of patients appear month after month, and many of them getting heavy doses; yet comparatively few of these people actually become addicts. In most cases the prescriptions call for less and less of the drug and the name finally disappears from the list. This is not assumption: we have the names of the patients and their physicians.

I believe that if 100 sick people took narcotics regularly for two months, with a control experiment on 100 well people taking the same dosage, a much larger proportion of the well than of the sick would become addicts; and I also believe that the greater incidence of addiction in both classes would be found in persons between 18 and 30 years of age. This is in accord with our experience with alcohol. There are hosts of alcohol tipplers but comparatively few confirmed inebriates. The age incidence, however, may differ from that of narcotic addiction. Yet the total consumption of alcoholic liquors by tipplers is far greater than that by confirmed inebriates. If we had statistics on the consumption of narcotic drugs by the various classes of users, which we have not, I believe that drug tippling would bulk vastly larger in the consumption than would drug addiction. While I believe that drug

tippling is more apt to lead to addiction than is liquor tippling to inebriation, yet the fact remains that there is a vast deal of drug tippling which does not lead to confirmed addiction, more with cocaine than with opiates but a considerable amount with opiates also.

We will have a demonstration of this principle after prohibition goes into effect, as far as alcohol is concerned, for the tippler will doubtless be a brief problem but the inebriate a serious one for years. Were prohibition against narcotics to go into effect at the same time, the hosts of drug tipplers who are misnamed addicts would soon melt away, while the confirmed addicts would remain a problem, some of them as long as they lived. In a small way we have this experience when we undertake to clean up a town where drug peddling exists. Most of the "dopes" are soon nearly normal, only a few giving real trouble.

Among industrial workers I believe drug tippling to be as common as among other employed people, but, so far as I can ascertain, and I have made rather wide special inquiry along this line, drug addiction is not at all common among the better class of industrial workers. The better the enforcement of law, the less tippling with drugs exists, for the tippler will not go the same length to obtain drugs irregularly as will the addict. With adequate laws definitely enforced, drug tippling could be all but eliminated; and with the laws as they are, the executives ot manufacturing plants could suppress drug tippling in their communities to a very great extent. Stop drug tippling in a community by arresting the right people—usually a few peddlers, one or two degenerate doctors, and perhaps a crooked druggist—and the making of new drug addicts would soon come to an end. There are communities where this has been done in which drug addiction has almost disappeared. There remain, of course, a few confirmed addicts and some aged and infirm people who seem to be unable to break the habit.

Industries have this matter largely in their own hands. The authorities will cooperate in any town where they are definitely asked to do so and are backed up by public sentiment without political flavor. But where there is timidity, a shutting of eyes to actual conditions and to the people responsible, where no one will appear willingly at hearings to testify to what he knows, where somebody has to be "protected," where professional reformers of no experience with addicts and their devious ways are placed in charge, and where the whole plan leaks out before arrests are made—in these communities little can be done. It is a business, legal and police matter, just the same as an epidemic of petty larceny in a community.

There are addicts who seem to keep in good condition for many years. Yesterday I examined one such and could find no symptoms of note. He is a man 53 years of age, holds a responsible position, is highly respected—in short, a man of refinement and education and possessed of many virtues. He looks well, works hard and has no disease except a slight prostatitis. Yet this gentleman takes 25 grains of morphine daily and has done so for fourteen years. He has taken as high as 40 grains in a day and is in a state of marked nervous trepidation if he reduces below 15 grains a day. Such cases, and there are many of them, baffle the theorists who essay to account for drug addiction on the basis of some disease complex. Yet such cases bear out my contention that drug tippling may never become drug addiction in some people, in fact in many people. When I say these people do not become drug addicts, I mean in the commonly accepted sense. Their peculiar form of addiction seems to be necessary to maintain their normal efficiency; and they display not the slightest desire to stop taking opiates.

I never knew how many individuals of this type there are until after the law made it necessary to report them to this bureau. Almost invariably they are people of importance in their communities, some of them executives in banking, business or industry. The dosage taken by them varies widely, some take as little as one-half grain of morphine a day. These people differ from the drug tippler, for the tippler takes the drug intermittently.

The worst class of drug-takers are not found in the industries at all, so the industrial world does not have to meet the situation in its more serious phases. The industrial worker, if he becomes one of the degenerate type of addicts, does not re-

main an industrial worker; he is physically unable to work and would not be tolerated by his fellows if he tried to do so. The average industrial worker despises the "dope" and promptly reports any such discovered. Labor unions rarely tolerate the confirmed drug-taker, and he loses his union card. Yet a degree of prophylaxis in an industrial organization is advisable. Morale should be kept up in every way and the idea disseminated that it is not manly to tipple with "dope." The "Treat 'em Rough" idea as regards peddlers of drugs will make this cowardly class keep away from the works. Good housing, prompt attention to illness and disability, sanitary surroundings, a minimum of night work, reasonable regulations regarding the use of alcoholic liquors, and an interest in the men and their families, will go a long way to prevent drug tippling.

Having discussed the problem in general, we will now consider a survey of some of the industries. This survey is not based wholly on our own observations, since numerous industrial physicians have furnished us with data, some to be credited to them and some already embraced in what has preceded.

Drifting labor—the casual workman and the gangs collected to meet industrial emergencies—must first be noted, for there is a great incidence of addiction and drug tippling among this class. This is not true of foreigners, for there is no great amount of narcotic-using among the races from Europe most employed in industry. The physicians of Europe employ narcotics most sparingly, and the European laborer, in consequence, seldom is a drug addict. But the class of native Americans who drift, many of them men who have left regular occupations on account of their habits, are deplorably given to the use of alcohol and narcotics.

The American negro is, seemingly, a willing addict. This is especially the case in the South and in the slum districts of northern cities, as well as among domestic servants and hotel employees; but many of the industrial workers of this race become addicts, drift from place to place, and often have police records. Some of the negro labor camps in the South simply breed addicts. They are deplorable places, as I can testify from observation. The men work about four days in the week and "celebrate" the rest of the time, usually by taking a trip to another camp, where high carnival is held—carnival which involves the use of considerable cocaine or other narcotics when they can be obtained. The supply is usually irregular, and hence there is more of drug debauchery than of regular addiction; but the participants become regular addicts if they leave the camp and take up city residence.

Gang labor at seaports is notoriously given to drug addiction. Baltimore and New Orleans are especially bad in this respect, for there are many vessels putting in at these places from South American ports, mostly tramp steamers, and their crews have a good opportunity to bring in opiates. The large vessels have better crews under better discipline, and there is less drug traffic from such vessels. The internal revenue agents keep this traffic down in large measure but are unable wholly to suppress it. Negroes are also employed largely at these ports—a fact which accounts for many of the bad conditions. I was told at Baltimore that probably much of the narcotic supply smuggled in there comes from Brazil. At New Orleans the geography is such as to make smuggling from small vessels very easy. Then, too, the Mississippi traffic is extensive, and I noted a preponderance of negroes on many of the boats, even up as far as St. Louis, where negro labor is employed largely along the waterfront.

Gang labor along the Mexican border is less of a problem, for the Mexican has an assortment of strong alcoholic beverages which make mere opiates superfluous to him. Yet he is keen for an easy profit, and I learned at Tia Juana, near San Diego, Cal., as well as at other border towns, notably Juarez opposite El Paso, Texas, that smuggling of narcotics is profitable. I was in California during one of the I. W. W. disturbances, and learned that this group of men is partly recruited from workmen who become industrial outcasts from indulgence in alcohol and narcotics.

New York and Boston harbors are under such close surveillance that it is not probable that great quantities of narcotics come in undiscovered; but along the Maine coast there are so many places where small vessels can put in undetected that there

is plenty of opportunity for smuggling. The Bay of Fundy offers splendid opportunity for the smuggler from Canada, since small vessels come and go under very slight supervision, and the fisheries employ thousands of men of the drifter class. They live in camps and move on after the season is over. Yet at Eastport I was informed that if such traffic exists it is not noted locally, for the typical population of New England is not of the sort given largely to drug addiction. Inquiry among some of the industries in New England revealed very little of a narcotic problem.

We get, however, great quantities of narcotics through smuggling from Canada, probably principally from the lake traffic, through Detroit, Buffalo, Chicago and Cleveland. My own observation in these cities has been too casual to justify expression of opinion, except to say that in all of them there is considerable drug addiction among floating industrial forces. So far as I know, however, there has been no intensive study of the problem in these cities.

We need special treaties with Canada and Mexico designed to suppress the traffic in narcotics which, if reports are correct, has grown to rather large proportions.

There is always a danger that the floating labor gangs will corrupt the regular forces. Some of this was noted during the pressure of war production, when labor was hard to procure and few questions were asked. We heard of instances in Pennsylvania, but the trouble was promptly corrected. There was also similar trouble reported in Connecticut, though I do not know the facts. There are drug peddlers among floating labor, and these men must be carefully watched.

With reference to war conditions, the chief physician of a large electrical manufacturing company in Pennsylvania writes:

> "Last summer, during the unusual labor conditions, when almost anyone applying was able to find work of some sort, I believe two or three addicts were employed whose habit was afterward discovered and which made them ill-fitted for their work, and they were discharged."

In reference to the usual routine in that extensive establishment, the same physician writes as follows:

> "All employees are examined before engagement, but this examination is directed chiefly at major defects which would concern a man's placement in industry. For instance, the eyes are tested, inquiry made as to lung troubles and wherever necessary examination made for these; the heart is examined; also examination is made for the presence of hernia and any other defects which may concern the man's occupation directly. In regard to drug addicts, no direct inquiries are made and it is quite possible that some addicts are employed who do not show contracted pupil, characteristic skin or other signs which would readily call attention to their condition. I doubt very much if many confirmed addicts have been employed here, and we have no reports coming to us in the works, or in either the hospital administration or welfare work, of any case of the sort."

Yet this report comes from a city where addiction has been found to be more than ordinarily common. Doubtless drug tipplers would pass the examination, or at least some of them would; but it is altogether likely that most drug tipplers employed regularly in so well-ordered a plant would cease the use of the drug. It does not seem to me necessary for an industrial plant to set out a drag-net for minor disabilities or minor addictions.

The drifters who go out with circus labor gangs, carnivals, amusement park attractions, etc., have given us considerable trouble. Gangs of strike-breakers, men employed on large outside construction work, the extra forces engaged in loading and unloading vessels during the war, etc., are reported to have had an unusual number of drug addicts among them.

Where definite statistics have been collected, "transportation workers" have figured considerably. But when one realizes that "transportation" covers a multitude of workers, there need be no alarm felt. Transportation companies employ a great number of drifters at times and a large proportion of employees are only laborers. Then, too, every jitney driver, hotel bus driver, elevator operator, chauffeur, ferry boatman, etc., is engaged in transportation.

When one inquires as regards engine drivers, conductors, other train employees, dispatchers, motormen, etc., there is little evidence of drug addiction among the personnel. The chief medical examiner for one of our large trunk-line railroads writes:

> "In our railroad relations we have come in contact with very few, if any, cases of this char-

acter [addiction], for, as a matter of fact, all employees entering our service are required to undergo physical examination by one of the company medical examiners, and those in whom drug addiction is suspected are declined employment. Furthermore, railroad employees, particularly those engaged in train service, are periodically examined, and the regular hours of employment and nature of the work naturally precludes a tendency to the development of the drug habit."

Some ten years ago, when making studies in the sanitation of public carriers, I encountered no complaints regarding drug addiction among the workers. As regards the train operating forces of transportation companies, we have had no complaints whatever come to this bureau.

Heavy outdoor employment does not lead to addiction. Farmers are not given to drug-taking on account of employment, but they often become addicts on account of neglected physical disability and the distance which they live from a physician. In former general practice, before the Harrison Act was in force, when called to see a person some distance in the country —it was a Pennsylvania German neighborhood—I would usually find the family had not summoned me until after the patient had been ill for several days, and, if the trouble was painful, until after free use had been made of the laudanum bottle, kept well-filled in every household. Yet there was little addiction among active farmers, although laudanum was used as a matter of course for many troubles. This was not the case among retired farmers, invalids on the farms, tenants, domestic farm help, and the much-harassed farmers' wives. Among these people there was much addiction, and our reports in this bureau, while showing less free use of narcotics in rural communities than formerly, do very positively show a *per capita* consumption of opiates in the small towns and villages adjacent to the farms where the drugs are secured from physicians or on prescription, very far in excess of the *per capita* consumption in the large cities. We cannot get separate farm statistics that are worth much for the reason that the purchases or prescriptions are secured in town; but we have an altogether out-of-proportion list of rural dwellers on our addict lists. They are mostly invalids and aged people.

In welfare work, industrial medical service, sanitation, etc., the largest industry of all, farming, is sadly neglected. These factors, not the work itself, account for a very large rural incidence of drug-taking.

Much the same must be said of lumber camps, isolated mines, and other heavy industries in rural environments. There is much drug addiction in these places based on the human element, not on the character of the work itself, for work does not breed addiction. A physician in a well-managed anthracite mining industry writes:

"I have had no mine workers as patients who could be classed as drug addicts, alcoholics excepted. I have made inquiries of my fellow practitioners in my own and surrounding towns and find that as a class anthracite coal miners and mine workers are exceptionally free from the use of morphine, opium and cocaine."

My own observation confirms this report. But it must be noted that anthracite mining is a highly developed industry, in places of considerable population and, usually, with good medical service supplied. The contract doctor, however, is not always what he ought to be; and this particular system of remuneration for medical service throws too many temptations in the way of physicians who are inclined to make a little money on the side. Some of the worst medical offenders against the narcotic laws in Pennsylvania are in towns adjacent to the coal mines. We have been obliged to take legal steps with some of them and are securing evidence against others.

I believe that conditions are worse in the bituminous industry, more especially in coke-oven towns. Bituminous mines are often in small places and the poorer grades of such coal are processed. Here there is negro labor, often a poorer grade of white labor, and the housing conditions and the general sanitation are poor. Conditions are worse in Colorado and the southern mining sections than in Pennsylvania, with, of course, an increased incidence of drug addiction. It is possible that prohibition in these latter regions turns many miners from alcohol to drugs. I was in the Colorado coal mining district during the trouble there in 1913, and I found wretched conditions in many ways. Here in Pennsylvania our trouble has been with drink, and comparatively little with narcotics.

In considering the problem of drug addiction in the more skilled lines of industry, I will quote from a number of letters received from industrial physicians. A physician in the medical department of a large optical goods manufactory writes as follows:

"I can truthfully say that during my six years' connection with this company I have seen not a single case of drug addiction. . . . . The question is directly comparable to the venereal problem. No doubt we have our full quota of drug addicts as well as venereal diseases, but they do not under the present general policy in industry come near the medical department, for obvious reasons. This policy is in a fair way to be reversed very soon, I believe, and then we will have a different story to tell."

Another industrial physician—in the relief department of one of our largest manufacturing concerns—thinks drug addicts are little of a problem in industry, and he goes on to say:

"In the eleven years that I have been associated with this work, supervising from ten to thirty thousand men, and having all cases of a suspicious character referred to the department, I have encountered but two cases. Both were physicians, I am sorry to say, one an American and the other English.

"There may be isolated instances of drug addicts employed in the industries, but I am confident that the gravity of the situation is grossly exaggerated, and I doubt the government's figures, namely, that the per capita consumption of opium in the U. S. A. exceeds that of China. This seems to me to be a vile slander. Persons so addicted are unfit for industry, and are self-eliminated.

"Approximately five grains of morphine per month meet the requirements of this industry, employing in excess of fifteen thousand men. . . .

"I am very much interested in your inquiry, for if there is some way of detecting drug addicts, and if we have them without knowing it, we would like to be informed.

"I have passed your letter around among nearly all our physicians, and none of us knows of a single case of drug addiction at the present time. When the Harrison Act first went into effect, prescriptions were brought to us for cough cures, and for hemorrhoid remedies, that contained extraordinary quantities of opiates, requesting us to copy these prescriptions, as the druggists would no longer fill them without a physician's signature, and his license number attached. These people were innocent, I believe, of having acquired the opium habit, and were led into it by the habit of dispensing pharmacists filling prescriptions from time to time and passing them on from patient to patient without a physician's sanction. When such prescriptions were presented to us, we absolutely refused to accommodate any patient in this line; but we did offer to write prescriptions to meet the same indications, but with opiates omitted."

The two men last quoted represent factories of the most advanced type, doing elaborate medical and welfare work; yet they have made no particular survey as regards narcotic addiction. Employers are being awakened to the venereal incidence in industry; and they will, in time, awaken to the fact that there is another secret menace which they must ferret out and destroy, be it a large or small factor numerically considered.

Five grains of morphine per month for 15,000 men is a record that prompts me to remark that there are very many small-town physicians whose morphine purchases are very much in excess of that of the average large-city hospital. One physician's purchase record lies on my desk now, since complaint has just come in regarding him. During the last four months he purchased 26½ ounces of morphine and 10½ ounces of cocaine. Another physician in the same up-state industrial city purchases nearly as much. What do they do with it? That is a matter for this bureau to determine. If we get the facts and they come out at a hearing, there will probably be some astonished industrial physicians in that municipality.*

A practical difficulty faces the industrial physician—the fact that the detection of drug addicts is not easy. The following letter from the medical director of a large tire and rubber company, in Ohio, illustrates the point.

"We unquestionably have many who are working for us and who are drug-users, but we have been able to isolate and eliminate only a few. I think I am safe in stating that in the past year we have been able to eliminate only three—two men and one woman. This information was secured not with the idea of determining whether they were using a certain drug or not, but in getting histories with reference to accident or sickness from which they suffered."

And this letter from the physician of a large steel works in Pennsylvania is along the same line. He says:

"During the past fourteen years at ———, I have come in contact with only two cases, one a cocaine user and the other a morphine user. In

*These men were arrested later, and the worst offender had his license to practise medicine revoked.

physical examinations it is impossible to detect them unless we see some definite evidence of their using drugs, as all of them deny it."

A physician in charge of the work in one of the largest shipbuilding companies in the East writes:

"For myself, I must confess I find it very difficult, if not impossible, in the process of the physical examination which I give the prospective employee, to detect the drug addict unless scarred by the use of the needle, as in one case that came before me. I have had several pass through whom I suspected, but I know of no test which would prove positive in the diagnosis of the ordinary moderate drug-user which would be of much service in one short interview."

The plant physician of a ship and engine building company says:

"The only way that we have at present of discovering drug addicts in this plant is the physical examination given to workers who desire to join the Beneficial Association. While this society does not have a membership of all employees, it covers quite a large proportion of them. During the above examinations we have discovered but one man who was addicted to morphine. He held a clerical position in one of our yard offices. We endeavored, unsuccessfully, to treat this patient, and he finally was released from the employ of the company.

"It is my personal opinion that the shipyard work is of such a strenuous character that any one addicted to the use of drugs could not withstand the strain of employment and drug cases would be self-eliminating."

Evidently there is a weakness in detecting the average drug addict and in diagnosing the suspected case. In this bureau we find evident little inclination to report cases. Although the Pennsylvania law makes mandatory on physicians the reporting of cases, if, after a physical examination, the physician continues to prescribe narcotics for an addict with the aim of curing the addiction—and he may not otherwise furnish any narcotic whatever for the purpose of satisfying the craving for drugs—not over twenty drug addicts have been voluntarily reported by physicians. So we have had to depend upon reports from druggists, who have notified us of very many cases, and on a system of follow-up that involves sending a form letter to every physician who is noted on our records as issuing heavy prescriptions for narcotics. We usually get courteous replies from the physicians to whom we write, but without reference to specific cases the physicians seem indifferent.

In the heavy industries employing skilled labor I find little evidence of addiction among the better class of workers. The chief surgeon of one of the largest steel corporations says:

"We have had no trouble with the drug addicts. Through my association with men, I recall three cases, two morphine and one cocaine. As a rule, the fellow workmen are very keen in detecting anything of this nature and report it."

As this corporation is a Pennsylvania concern, I took occasion to check up on it and found a dozen or more cases of addiction among their workers, chiefly among negroes; and, for a while, two drug peddlers were working for them. We promptly attended to these cases and stopped the two physicians, and the one drug store that were responsible for conditions. The two physicians were practising in adjoining towns, and not one of the employees retained his place for long. One peddler was sent to jail and the other absconded and has not been traced in this state. He was last reported in Cleveland, Ohio, and was duly reported to the federal authorities.

A very frank chief surgeon in another large steel industry writes:

"We have very little opportunity to accurately ascertain how much drug addiction there is in the iron and steel industries. I am inclined to think, however, it is extraordinarily small. During the past ten years, only two or three cases have come to my personal attention and they were negroes and were cocaine and heroin addicts."

The physician in charge of a large Michigan automobile factory writes:

"We have never yet had to deal with a drug addict. I don't think one could pass the employment department and get to work in the factory. If he did the foreman would detect *something* about him—enough to let him go without sending to the medical or welfare departments."

The director of the department of health in an extensive rubber goods plant in Ohio writes:

"In the three and one-half years in which our department has secured a fair medical control of the industry, we have not detected any drug addicts applying for employment, nor have we found any in the industry. The percentage that are in the employ, or who have been employed, cannot be very high because of the fairly well-developed medical control."

In the lighter industries employing skilled labor I can find little evidence of

addiction. It is unskilled labor, here as elsewhere, that is the more given to addiction.

The medical director of one of the principal New York chemical industries, speaking of addiction, writes:

"It has been so infrequently observed among our employees as to constitute a negligible factor in our labor turnover or absenteeism."

The medical officer of large telephone interests reports:

"Up to the present time we have failed to detect any drug addicts among our employees. We are keeping close observation along these lines."

A member of the medical department of an extensive silk manufactory in Connecticut writes:

"We have practically no trouble with addicts. In fact, in the three years of my connection here, I do not recall a single instance of opium or cocaine addiction, although we did have one case of chronic acetanilid poisoning from headache powders."

These three letters are representative of the reports I have received on the lighter industries. Companies employing many women have observed more or less absenteeism on account of menstrual difficulties, and some of the women take narcotics at that time. A tactful matron in the factory can readily adjust this factor. The chemical industries handling narcotics in quantity have to face, not so much the addict, as the thief who is in alliance with outside drug peddlers and seeks employment in the works.

The letters quoted are from industrial plants wherein the medical service has been properly organized; but such industries are in the minority. There are far more companies that leave the medical care of their workers to chance. In the industrial communities infested with physicians who are themselves drug addicts or who exploit the addicts for gain, there is a great industrial danger. I wish to say to the managers of industrial plants in Pennsylvania that this bureau will welcome complaints against such physicians; we will investigate the matters complained of, and will proceed against these men if the law and the evidence warrant.

The social and personal factor enters largely into addiction; it is too large a subject for detailed discussion here, so only one letter is quoted—one from the physician at a large thread manufacturing plant. He says:

"During my three years' experience with this firm, I have seen but five cases of drug addiction. During this period I have probably examined in the neighborhood of 5,000 applicants for employment and in addition to these made numerous examinations of our permanent working force as they came to the mill hospital for treatment.

"The first was a man who had been in our employ for about twenty years. For the last ten years he has been suffering from an acute inflammatory arthritis and his physician had been prescribing morphine to alleviate the pain. This man, at the time I saw him, was in the habit of taking about 1½ grains of morphine a day, buying for that purpose veterinary tablets of one grain each and taking before retiring, later increased to 2½ grains per day. How he got the drug I could not ascertain, as he informed me he was afraid of making trouble for the person who was getting it for him.

"The other four cases have all come under my observation within the last six months, three being young men and one a young woman. The young men, curiously enough, all gave the same history of the beginning of this habit, although it was contracted in very different sections of the country—one in Boston, one in Hog Island Shipyards, and the third at Charleston, S. C. Two of these men have just been discharged from the United States Army. The story they all told was that they received the first dose from prostitutes in whose company they had been. They were given heroin by these women because they had been drinking very heavily the night before, and were given this drug to brace them up so they could report for duty in good shape in the morning.

"Evidently this treatment was so efficient that on future occasions they had resorted to it for the same purpose and gradually had become addicts.

"The girl came under my observation complaining of a sore throat which I suspected was specific, and I found out from her that she was not really a habitué but would use the drug whenever it was obtainable and had attended 'parties,' as she called them, in Springfield, Hartford and Boston, where young couples would congregate and have these narcotic sprees. She informed me that cocaine was much preferred by these people owing to the more exhilarating effect.

"I referred one of these young men to the Massachusetts State Board of Charity for admission to an institution for treatment, as he was anxious to break away. The others, however, did not care to take any treatment and undoubtedly they are still using drugs. None of these people seem very anxious to secure employment, and when they found that I suspected their condition they were free to talk about it.

"I feel that the reason for the small number of addicts seen by a physician in industrial practice is primarily due to the fact that these people have no desire to work if it is possible for them to secure their supplies of drugs in any other way.

I found on questioning these young men, and also found the same thing during my hospital work in Boston, that a large number of them live on the earnings of immoral women, with whom they cohabit and where these men are able to secure their drugs.

"In my estimation, an efficient step can be taken to offset this evil by a closer scrutiny of narcotic *prescriptions* and more stringent legislation on the *prescribing* of narcotics, as I feel that a large number of addicts secure their supplies through prescriptions written by physicians.

"Regarding employing this type of individual, I would hesitate to accept a pronounced drug addict, as from experience in a large municipal hospital in Boston, where we had a number sent by the court for treatment, I found they were capable of little or no physical effort and of absolutely no concentrated mental effort. In addition, I found they are extremely dishonest and unreliable. I feel that they would constitute a pronounced hazard from an accident standpoint because of lack of concentration when operating machinery."

What a story! Yet I could duplicate it many times. It is narrated here to emphasize the fact that drinking leads to venereal excess and that to drug habituation. I do not believe, however, that as a rule, drug habituation leads to drink. What prohibition will do to the drug problem is uncertain. Personally, I seriously doubt if it will increase drug-using the country over, though it probably will have this effect among the submerged element in the cities.

The aim, in this paper, has been to adhere as closely as possible to ascertained fact and to avoid extreme view. There is a paucity of dependable data. Opinion expressed has been based on thirty years' medical practice and such study of the narcotic situation as a state practical administrator may undertake.

Careful comparison of opinion leads to the view that the anti-narcotic propagandist has overstated his case, and there is so little disinterested opinion that the propagandist's claims have not been checked off against the opposition. Virtually there is no opposition, as there is in the matter of prohibition; but there is inertia on one hand and more or less hysteria on the other. The propagandist has had things largely his own way, and there has been almost no contained and scientific study of the problems involved.

The question is more sociologic than medical, legal than physiological, practical than academic. Laboratory study will not settle it, nor will empiricism cure the ills encountered. The medical clinician is of the wrong temperament to make rapid advance in this reform, and the police power fails to realize the human side sufficiently. Mere propaganda does not get at the facts nor does it reach the persons involved. Only by practical administration will much be accomplished—an administration that faces the facts, gives the clinician his proper place and no more, turns a deaf ear to commercial exploitation of so-called cures, does not yield to the psychologic bent of the addict, and fearlessly executes the laws in a spirit of fair play and with the public health factor always in view and superior to the clinical one.

There is no medical agreement over this question, nor is it likely there will be for many years to come. Pharmacology will not reach definite conclusions, nor will so-called rational therapeutics, since too many unusual factors are involved. As between the two classes of medical practitioners, one, to which the writer belongs, which adheres to the view that the proper therapeutic use of narcotics is in emergency only, and the other—largely represented—which regards the use of narcotics as a necessary routine in every-day practice, there is little agreement. It is the "sacred prerogative" of many incapable physicians to relieve pain and discomfort of the moment, and the average unthinking layman backs him up in it.

The sanitarian views many things differently from the clinician; he must do so in order to advance. Medical convention means little as against "the greatest good for the greatest number." The medical prerogative must give way to the public need. It is, perhaps, unfortunate, but we can no longer afford to leave the control of the narcotic menace wholly in the hands of the clinician; as a rule, he sees only one side of it. We must have a standardized and authorized rôle for opiates and other habit-inducing drugs in therapeutics, and the clinicians of every shade of opinion must be made to conform to a sound public policy and proper administration of the laws. In view of the narcotic menace, such a policy compares with our control of explosives, lethal poisons and other intrusions on "personal liberty." We must come to it sooner or later in our control

of narcotics, for it is by unrestrained prescribing that a large proportion of addicts are made and addiction kept up. Scientifically restrained and legitimate use of narcotics should not be interfered with in administration.

Business and industry intervened in the alcohol menace, and they, even more than the temperance reformer, are responsible for the public opinion that has swept state after state into the prohibition column and now has made prohibition the national policy. Yet, despite this, the "sacred prerogative" of thousands of liquor-prescribing physicians is a quite unnecessary loophole in the liquor laws—a loophole which will eventually be realized—and a standardized and authorized rôle for alcohol in therapeutics will have to be adopted in order to protect the people from a certain minimum number of physicians.

And business and industry must intervene in the narcotic menace and create a public opinion that will sweep aside the petty contentions of the patent medicine interests that the present exemptions per ounce in the narcotic laws are justified; a public opinion that will not permit the old empiricist with M.D. after his name to supply opiates year after year to every case of what he is pleased to call "neuralgia", "chronic bronchitis", "chronic diarrhea", "asthma", "heart disease", "piles", and what not.

Business and industry must make it their care to see to it that the narcotic laws are enforced as effectively as are any other necessary statutory enactments. The few debased physicians who infest almost every community and who deliberately keep up addiction through ignorance or cupidity, must be definitely taken in hand. The "jokers" must be taken out of our narcotic laws; a vast excess of importation of narcotics must no more be permitted than is an excess importation of alcohol, dynamite, or undesirable aliens. Substitutes also must come under the law. Hydrated chloral, cannabis, hyoscin, and similar drugs must not be allowed a foothold in the United States. Why should we permit the free sale of chloral just because a certain number of proprietary medicine makers profit by it? The heroin problem must be dealt with in a practical way. In many ways heroin is the worst habit-forming drug known, and its every legitimate application in medicine can be filled by other drugs. In Brazil cannabis smoking is becoming a national menace and the vice can readily be imported. Why allow it to be? The cannabis smoker nearly always becomes an imbecile in time.

Industrial physicians by studying the problem of drug addiction in its industrial bearings, by making surveys and by developing statistics can do much toward clarifying and solving the whole problem of drug addiction.

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PROBLEMS IN THE TRAINING OF INDUSTRIAL NURSES*

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During the months that have passed since the signing of the armistice, hundreds of nurses discharged from military service under the Red Cross and the Army and Navy Nurse Corps have been returning to civil life and work. Many of these women, like many of the men returning from overseas, are disinclined to take up again the work they had previously done. Part of their restlessness is due, no doubt, to the nervous strain of their military service; part, perhaps, is dissatisfaction with the commonplace of ordinary life after work in which, though tedious at many times and arduous at all times, they nevertheless had constantly the support of great motives. But no one who has talked with returning nurses can fail to see that many are coming home with clearer vision of values, and with stronger desire to utilize their technical skill completely and to devote their spirit of service to constructive work.

To women with such desires public health nursing in its various branches naturally makes a strong appeal. This rapidly expanding field offers unprecedented opportunities for constructive work, and calls for greatly increased numbers of specially trained workers. Many returning nurses have already accepted positions in public health nursing, and it is significant that a large proportion, among them women of proved executive and teaching ability in other lines of work, are showing special interest in industrial nursing.

From every point of view, the best possible preparation for industrial nursing should be available at the present time. In the first place, we have now a comparatively large number of nurses free to choose new lines of work. These women deserve the best preparation, not only because they constitute on the whole a specially selected group, but also because they are eager to obtain it, even at the expense of considerable time and effort. Moreover, the money difficulty, usually a serious obstacle in obtaining post-graduate instruction, has this year been reduced to a minimum; for the Red Cross, recognizing on the one hand its obligation to nurses who have been in service, and on the other hand its opportunity to further public health work in needy communities, has established a scholarship fund of $100,000 to enable nurses to secure special training in public health nursing. Thus we have the unusual combination of personnel and money, to some extent simultaneously available.

Not only for the benefit of the worker, however, is adequate preparation needed, but even more for the benefit of the work. The value of industrial nursing has indeed been conclusively demonstrated; yet the development of the work is in its very beginning. The field of industry offers enormous opportunities for health work for the benefit of groups otherwise difficult to reach. While public health nurses reach mothers, babies, and children in their homes, and children again in the schools, in neither of those places can they reach adults and children employed in industry, unless indeed the workers are compelled by sickness to remain at home. The industrial nurse, therefore, since she spends her working day in the factory, is in many instances the agent on whom we must mainly rely to instruct industrial workers in the ways to prevent sickness and to maintain health. On these subjects it can safely be said that most industrial workers are profoundly ignorant. Yet their health and physical efficiency are undoubtedly determining factors in production, and their well-being of mind and of body is an essential part of the whole complicated structure of industry. Clearly, industrial nursing with its rich opportunities demands expert workers with the soundest kind of technical training.

For many reasons, nurses have proved to be effective health workers. Knowledge of sickness is a necessary foundation for health work. Power to recognize devia-

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tions from the normal is essential to understanding what constitutes health, and thus for working toward the normal with aims that are clear and means that are definite. But nurses have a further advantage: they are recognized and welcomed by those whom they wish to reach, largely because they can and do care for the sick. For a generation district nurses have been nursing the sick in their homes, and have established such traditions that their services are valued, their motives are trusted, and their advice is followed to a considerable extent. The nurse's hospital work, consequently, is a necessary part of her preparation. Yet ordinarily the graduate of a nurses' training school is not satisfactorily equipped for industrial work, or indeed for any other kind of public health nursing, until she has had further training.

Public health nursing, it should be remembered, did not exist a generation ago when the first schools of nursing were opened and their system of training was established. The original objects of the schools of nursing were, first, to provide skilled nursing for the patients and to improve general housekeeping conditions in the hospitals, and, second, to provide nurses for private duty in the homes of the sick. So far as carrying out their original purposes went, training schools for nurses have proved eminently successful. No other method has yet been devised to nurse satisfactorily without prohibitive cost the patients in large hospitals. Indeed, financially the schools have been too successful, with the unfortunate result that many have been established in connection with hospitals quite incapable of maintaining respectable standards of teaching, either because the hospitals are too small or too specialized to give adequate experience, too poor or too ignorant to provide proper teaching, or even perhaps altogether lacking in intention to furnish adequate instruction in return for the hard labor exacted from pupil nurses. Such hospitals, in order to obtain a sufficient number of pupils to carry on their work, have necessarily kept their standards of admission so low that many of their graduates, through no fault of their own, prove unfit for positions in public health nursing on account of their limited education and inferior training. Probably enlightened public opinion only can ultimately eliminate these unworthy schools, and stimulate the others to meet more adequately the demands of modern nursing by enriching their curricula and setting for themselves higher standards of educational efficiency.

The secondary object of the training schools was to prepare women for private duty nursing, and the schools have proved successful in achieving this object also. Private nurses, whose entire technical equipment has been obtained in a hospital, have now for a generation carried on much needed work in our communities, although its scope has been limited since the cost of continuous nursing service is prohibitive for the majority of sick persons. On the whole, nurses in the homes, like those in the hospitals, have performed their work well, and are justly proud of their record of service to the suffering. To be sure, nurses in common with doctors, lawyers, clergymen, and other professional workers are not infrequently weighed in the balance by the public whom they serve, and are sometimes, justly or unjustly, found wanting. But no one who has seen the despair, not to say the panic, exhibited by persons accustomed to obtaining easily the services of a nurse, when for any reason the supply of nurses is unusually diminished, can entertain doubts as to the real attitude of the public.

Upon nurses thus trained by methods originally planned to prepare them for hospital work or private duty, the rapidly developing public health work of the new century has made new and constantly increasing demands, many of which they have themselves been the first to recognize. While the private-duty nurse's work ordinarily is to care for the individual sick patient in the well-supplied home, carrying out medical treatment and nursing measures with intelligence and skill, the public health nurse must maintain standards of nursing even when every convenience is lacking. Necessities may also be lacking, and if so, she must know how to utilize community resources for assistance. She must understand the social causes of sickness, and social as well as medical treatment. She must know how to co-operate with other social agencies to promote family health and welfare. Furthermore she must be a teacher as well as a nurse, capable of instructing effec-

tively in sanitation, hygiene, diet, and simple measures of home nursing. She must not wait for patients to send for her, but she must know how to go out and find them for herself, and make them want the service she is so eager to render.

The need for special training to meet these and other new demands became increasingly evident as public health nurses gradually developed their technique and methods. Courses of instruction were organized in several places, generally in connection with colleges or universities where the required theoretical work might be obtained. At present about fifteen teaching centres in the United States are offering post-graduate instruction to nurses in theory and practice of public health nursing; but a number of these courses are still too new to be firmly established. Courses of instruction are now being planned in several other cities, and will be opened as soon as nurse instructors are available. These courses are in great demand, and most of them report full enrollments of students for the coming year, so that the outlook is encouraging for an increased supply of public health nurses in the near future.

The courses now offered in different colleges show certain similarities. The theoretical work generally includes bacteriology, hygiene, sanitation, and nutrition; the principles of sociology, psychology, social work, and teaching, with other subjects as electives; also lectures and conferences on the technical aspects of the work. Field work in practically all the courses consists of family health work in connection with visiting nurse associations, since the work in this field is the most comprehensive and is generally the best equipped for teaching purposes. This practice work is usually supplemented by further experience in one or more special branches of public health nursing, such as infant welfare, school nursing, industrial nursing, anti-tuberculosis work, medical social work, or family case work with relief organizations.

In courses such as these the best trained women now in industrial nursing have received their preparation, but the specially trained nurses who have been able to obtain post-graduate courses in addition to their hospital training are still comparatively few. For the pioneers in this, as in other branches of public health nursing, no special courses were available. While not a few of these pioneers succeeded through their own unguided observation, study, and experience in training themselves, yet it is true today that few nurses without post-graduate training progress far beyond limited remedial work, since their hospital training has not fitted them either to carry on health teaching or to see the rich opportunities for preventive work afforded by industrial nursing.

The problem of planning a special curriculum in preparation for industrial nursing presents certain difficulties. In the first place, though the value of the work is widely recognized and the demand for nurses exceeds the supply, yet the work itself is still in the pioneer stage. Almost no data are available as to the exact functions of the industrial nurse, or in regard to the training and experience from which the most valuable results are to be expected. Thus industrial nursing is almost completely unstandardized. Women of many different types, from the graduate nurse with special training in public health, down to the "practical nurse" or the woman whose only equipment consists of a short course in first aid, are now employed in industries, and all are commonly called industrial nurses; but only trained women who are actually doing preventive work are entitled to the name. A critical study of the field would contribute enormously toward clarifying the whole subject, and would lead inevitably toward standardization and development of more definite technique.

Progress in standardization, however, is greatly impeded since most employers, especially those employing one nurse only, have little or no knowledge of standards of nursing in general or of public health nursing in particular. They are consequently unable to judge the equipment of the nurses whom they engage for health work, or the kind and amount of work that should be accomplished. Such an employer, if he has good luck, may obtain the services of a woman of superior education, well-trained technically in one of our better schools of nursing, holding in addition the diploma of a special post-graduate course in public health nursing, and thus equipped to carry on really constructive health work among the employees in his

factory. But more probably he selects a nurse without special public health training. To him, as to many persons, a nurse is a nurse, without distinction as to special training and qualifications. He considers himself fortunate, then, if he can secure the nurse who made him so comfortable in the hospital when he had appendicitis, or the one who, he feels confident, saved the life of his wife when she had pneumonia. All he requires of her is to give first aid, which her hospital training has probably enabled her to render competently, to stay constantly in her first-aid room, and to wear an immaculate white uniform. He is quite satisfied to have her spend her time between emergencies in rolling innumerable yards of adhesive plaster, or even in knitting; and in too many instances, so is she. The work of such a nurse may be excellent as far as it goes, but it is limited because she does not understand preventive work. Far less fortunate is the employer if he decides, as many do, that all he wants is "a good, sensible woman," and secures a so-called "practical nurse." He ignores the fact that the best trained woman is in reality the most practical nurse there is, and forgets that "cheaper but just as good" is likely to prove a fallacy. Through ignorance, women of this type not uncommonly take upon themselves the functions of the physician, and thus become a real menace to the employees they may genuinely wish to help.

In spite of difficulties, the need for specially trained industrial nurses is so great that adequate preparation must soon be available. A few courses have been tentatively offered, and it is encouraging to note that the coming year promises wider opportunities for training. Such courses beyond question should include the fundamental instruction required in the courses for public health nurses already mentioned, with special stress upon hygiene, sanitation, and methods of teaching. This instruction should be supplemented by special lectures and conferences, including especially the consideration of such problems of industrial work as occupational diseases and health hazards, employment management, workmen's compensation and other legal problems of industrial disease. The practice should include work in an industrial clinic and in the nursing department of one or more industrial establishments whose standards and methods of work are suitable for teaching purposes. For successful work a sound general education is required, and it is encouraging to note the increasing number of nurses with college degrees who are showing interest in industrial nursing.

The time is clearly ripe for strong preventive work, both medical and nursing, in the industries. Much has already been accomplished, and recent developments in industrial medicine and surgery promise brilliant achievements in the near future. Invariably, well-educated and well-trained physicians demand well-educated and well-trained nurses, in whom they find their most capable assistants, and the same thing will prove true in industrial work. But in addition to her duties of assisting and co-operating with the physician, the industrial nurse has her special province. Upon her ability to organize and develop her own special work depends her ultimate value in industrial work.

BLOOD EXAMINATIONS OF TRINITROTOLUENE WORKERS*

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THE present investigation of the blood of 233 workers exposed to trinitrotoluene (trinitrotoluol), commonly known as T.N.T., was undertaken with a view not only to ascertaining the character of their blood changes, but also to see if blood abnormalities did not occur which would serve as a helpful guide to indicate the degree of poisoning. Symptoms, of course, might also indicate the degree of poisoning, but in some instances these might be misjudged or misleading, so that evidence of poisoning from blood examinations, like other laboratory data, might frequently afford important information concerning a patient. Such knowledge would help to indicate when an individual should be removed from his work so as to prevent the more serious forms of poisoning. It is well known that the most serious forms of poisoning with T.N.T. may result in death from a severe anemia of an aplastic type or, more frequently, from a severe toxic jaundice, associated at times with some anemia. The relation of these two conditions to each other has been disputed. However, it may be said that toxic jaundice has been reported with little or no changes in the blood picture.

The usual explanation of the action of T.N.T. is as follows (1) (2) (3): Trinitrotoluene acts to change the hemoglobin to a varying degree into a mixture of nitric oxid hemoglobin and methemoglobin. These forms of hemoglobin cannot act as satisfactory oxygen carriers and, as a result, directly or indirectly certain symptoms and signs are produced: breathlessness, dizziness, headache, faintness, palpitation, undue fatigue, muscle cramps, and particularly cyanosis. Often the affected individual has an ashen color or slaty appearance. Drowsiness, depression, and sleeplessness are also common. Associated with these symptoms, certain other symptoms occur, due wholly to the irritative nature of the substance or in other instances probably wholly or partially due to the entrance of the poison into the circulation. These symptoms are tightness in the chest and throat, sneezing, running nose and watering eyes, and dry cough; bitter taste in the mouth, often with lack of appetite. Nausea and vomiting, with various types of abdominal pain, often spasmodic, are frequent; constipation, diarrhea and skin eruptions are common.

As a sequence to the alteration of hemoglobin, increased blood destruction occurs, and its products must be disposed of, particularly by the liver and the kidneys, while the blood must be regenerated chiefly by the marrow. Evidence of renal irritation and the passage of very dark urine are not uncommon. If the liver fails under the increased pigment metabolism and the toxic action of the poison, jaundice will occur, usually with associated abdominal symptoms, including pain or tenderness in the liver region. If injury to the liver is severe enough, toxic jaundice will result; while if the blood formation, accelerated presumably not only by the products of blood destruction but by the increased oxygen-want, cannot maintain the blood at its normal level, anemia results. If the marrow is injured severely and fails to do its work, an aplastic anemia occurs. Our purpose is not to deal with these terminal conditions, but with the blood findings in a group of essentially unselected T.N.T. workers.

The blood changes in the milder, as in the severer forms of poisoning from this substance, and their significance have been discussed to a certain extent in the literature, but the reports are somewhat at variance with each other. A brief summary of the literature on this subject follows:

The blood findings in workers with other nitro-aromatic bodies furnish us with a

*This investigation was undertaken as a part of a general survey of the T.N.T. manufacture in the United States at the request of the National Research Council, with the co-operation of the United States Ordnance and Labor Departments. The work has been accomplished under the auspices of the Division of Industrial Hygiene in the Harvard Medical School, and in the laboratories of the Massachusetts General Hospital. Received for publication June 11, 1919.

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guide to what might be expected in the blood of workers with this newer product, trinitrotoluene. Though there is a variation of opinion among different observers, it is generally considered (1) that nitroaromatic bodies give a polynuclear leucocytosis, which is followed by lymphocytosis, and along with it occur changes in size and staining qualities of the red cells, the latter showing polychromatophilia and stippling. Hudson (4) considers that when the lymphocytes are over 30 per cent. and changes are beginning to occur in the red cells in nitrobenzol poisoning, and in experimental work on dogs in dinitrotoluene poisoning, it should be taken as a warning. In trinitrotoluene poisoning, Hudson (4) looks for similar changes, but no report of his findings is available.

Malden (5), in 1907, studied the blood of twenty-one workers in dinitrobenzol, and found the red count somewhat reduced, the red cells varying in size and shape, with always a marked basophilic granulation. This latter condition he considers the earliest observable sign of poisoning. The white count often was increased, with a considerable relative increase of the polynuclears. The eosinophil cells were sometimes, and the mast cells not infrequently, relatively increased.

The report of the British Ministry of Munitions (6), in 1916, states, without much experimental evidence, that in dinitrobenzol poisoning there is a conversion of oxyhemoglobin to methemoglobin, and that hemolysis may occur with degeneration of the red cells and methemoglobinemia. Nucleated red corpuscles may be found, and imperfectly developed red cells, stippling, polychromatophilia, and variations in size and shape. Lymphocytosis may occur. This report further states that the blood changes in individuals exposed to T.N.T. appear to be of the same kind but of a lesser degree. No further details are given concerning the blood in either dinitrobenzol or trinitrotoluene poisoning, though further investigations on the blood were stated to be in progress. I am not, however, aware of any further report unless it be that of Panton, which does not support the view that the changes in the blood in T.N.T. are like those in D.N.B. poisoning.

Panton (7) studied the blood of fifty individuals exposed to T.N.T., who were actually working; many of them were cyanotic, some pale. He found "the red cells and hemoglobin not adversely affected," and suggests that perhaps in some instances they may be actually increased under the influence of T.N.T. Except for a very slight degree of poikilocytosis, not an abnormal red cell of any sort was noted. The white cells in a large percentage of his cases were above normal, often over 10,000, with relative increase of polynuclear neutrophils. The eosinophil cells were in many cases above normal. He suggests that such findings are due to a stimulation of the hematopoietic system by the poison, and considers that "there is no evidence that daily absorption has any deleterious effect upon the blood." He noticed that about 20 per cent. of the workers often had an increase of bile pigments in their plasma, but evidently did not consider that such individuals were ill enough to put on the sick-list.

Panton (7) made a further investigation of the blood of individuals who were actually sick. Of twenty-eight cases of toxic jaundice, he states that only four showed what he considered blood changes of importance, and these changes were those of aplastic anemia. All showed increase of bile in the serum, its persistence during convalescence sometimes lasting for months.

Six cases of aplastic anemia due to T.N.T. are cited, with the blood findings of this condition. According to Panton, there may be a period of weeks between absorption of the poison and after removal from it, before the development of icterus, and even longer before aplastic anemia occurs. It is, however, I think, quite possible that serious blood changes can be found in at least some cases of this type at the beginning of the latent period which Panton describes.

The blood in a single case of toxic jaundice is reported by Livingstone-Learmonth and Cunningham (8). Shortly before death, the hemoglobin was 60 per cent.; the red count 4,000,000, with the cells showing only slight granulation; and the white cells normal.

Stewart (9), in contrast to Panton, found distinctly more blood changes in cases of toxic jaundice. He studied four-

teen cases, and noticed neutrophil leucopenia with lymphocytosis in nine. Serious anemia with the occurrence of blasts occurred in three cases. "A slight grade of chlorotic anemia was present in several," but the red count was over 4,000,000, including two fatal cases. "Slight polychromatophilia occurred in but one case, and stippling was not seen in any case."

L. H. Smith (10) reports a study of the blood in twenty-five men employed where T.N.T. was in a finely powdered form used in filling shells. None were sick, but a few had cyanosis and several had minor symptoms, such as skin rashes, abdominal pain, irritative cough, and bitter taste. No red cell changes or reduction of the red count or of the hemoglobin were noted. This agrees with Panton's observations. Smith, however, did find—as have others—that the white corpuscles were usually somewhat above normal. The highest counts were between 10,000 and 12,000, the polynuclears being in many instances increased. His table also shows that the polynuclears were not infrequently diminished. The eosinophiles were slightly increased in 40 per cent. of Smith's cases; the platelets appeared normal.

In a report on seventeen cases of T.N.T. poisoning in Massachusetts by Harrington (11), no reference to blood changes is made except the statement that blood destruction occurs.

Gregorson and Taylor (12) comment briefly on the blood of five individuals seriously poisoned by T.N.T., and Kramer and Meierhof (13) remark on the blood in one experimental animal, but give no significant information not already noted.

Koelsch (14), writing in Germany in 1917, states that pure T.N.T. has no special poisonous property, and does not affect the blood. However, he considers that tetranitromethane and sometimes nitrobenzol may be an impurity of T.N.T. from which symptoms may be produced in man, and that occasionally hematogenous jaundice results. Apparently he considers that dinitrotoluol can cause methemoglobin with solution of the red blood corpuscles and anemia, and that tetranitromethane can do the same. In another article, entitled *The Poisoning Effects of Tetranitromethane*, he considers this substance an impurity in T.N.T. which exists "due to war conditions," and that it is trinitromethane which causes the symptoms usually described in T.N.T. workers. He evidently considers that a general poisoning of the blood is not uncommon, but no statement of the blood findings is given, though numerous fatal cases due to impure T.N.T., as he calls it, are cited.

A letter from Dr. F. W. Lynch of the Central Laboratory at Queen's Ferry, dated 1917, considers that much of the T.N.T. manufactured contains tetranitromethane, and that it is this substance that causes the chief distress among the T.N.T. workers. However, it is to be noted that Moore (15) from his excellent work does not consider that such an impurity is the cause for the poisoning produced. It is, of course, possible that the varying reports on the blood of T.N.T. workers may be dependent upon variable amounts of some such impurity.

It is evident from the 233 cases that we have studied that abnormalities of the blood are common in T.N.T. workers, even when they have but minor symptoms, regardless of what may be the precise cause of their blood changes. The investigation of these 233 cases and the study of their bloods were undertaken in the following manner:

Six specially selected medical students (Alice K. Hall, William Herman, Jr., Jewel O. Emery, William Eversoll, Tracy J. Putnam, and Richard W. TeLinde) were sent for a period of weeks to six different T.N.T. plants, where they studied the industrial hazards and the clinical condition (chiefly symptomatic) of the workers. They made red and white blood counts and fixed blood smears, as well as making certain other laboratory examinations. Some of the clinical observations and some of the blood preparations were made by myself.

These 233 cases represent persons taken at random from some 600 individuals studied in eight different plants—individuals who were working in the different processes of T.N.T. manufacture, and in the loading of shells with this substance. The persons studied cannot be said to be selected except in the following way: Individuals showing definite sickness due to T.N.T. were, of course, always called to the students' attention, so that relatively few cases occurring during their residence

at the plants were not studied. While essentially all the available workers in a given plant were studied, of the cases not studied there were probably more with slight symptoms than there were with marked symptoms. The students' case records upon completion of their work, in conjunction with the blood smears, were studied by myself.

The blood smears from all the cases were critically examined by myself. Miss Anna Agassiz, who has had a special training in blood work, first counted 200 white cells, and observed with care the red cell changes. I then counted 100 (often 200) white cells in seventy-five cases and, if my figures agreed closely with hers, no further count was made and the average figure of our two counts was used. If any significant disagreement occurred—which was very unusual—further counts of 300 cells were made. After the first seventy-five cases were studied, I, personally, counted fewer white cells, and if my count approximately agreed with her count, her figure was used; while if there was not a reasonable agreement, further counts were made. The red cells were carefully noted by me, personally, in all instances. In some cases, certain features that I had not noted at first in a given smear would be called to my attention by Miss Agassiz's observations.

It is to be noted that the method of studying the cases is not an ideal one, particularly on account of the following facts. It was not possible to observe the blood of a given individual more than at one time except in a few instances, so that there are but few observations upon changes in the blood in a given case. Also there is but little data concerning the clinical symptoms following the day of observation and the blood exemination. The data concerning the symptoms were largely collected by different medical students. Thus not only may different students have had different standards for the degree of a symptom, but, being not wholly trained, certain points may have escaped their attention. When we compare the blood changes with the symptoms, therefore, the method of this investigation must be recalled. However, we believe that the essential points noted are correct. The results of these examinations were summarized for purposes of study in a manner similar to that shown in Table 1. This table gives examples of different degrees of blood changes observed, and their relation to the individual's symptoms.

For purposes of brevity and to avoid repetition of words, + signs have been used in the table and in the accompanying discussion, the significance of which is as follows:

Definition of + Signs in Table 1

Variation in Size of Red Cells. It is to be noted that the variation in size is comparative, and that the highest degree does not represent the highest degree known to occur in pathological conditions.

Slight + = A little greater variation in size than is probably normal, with very rare microcytes or cells definitely larger than normal.

+ = A definitely abnormal but only a slight variation in size.

+ + = A moderate variation in size.

+ + + = A marked variation in size, but never of as marked degree as seen, for example, in moderately severe pernicious anemia.

Variation in Shape of Red Cells, Not Including Fragmented Cells.

+ = A clear-cut but not marked variation in shape. This was the highest degree noted in this series.

Macrocytes.—It is to be noted that macrocytes in this study usually simply refer to red cells larger than normal, and rarely to macrocytes of a type that may be seen in pernicious anemia; though as a rarity, an extremely large cell, a real macrocyte, occurred.

Rare = One to two big cells in counting 100 white cells.

Slight + = A tendency to slightly bigger cells than normal, with distinctly bigger cells as a rarity.

+ = One rather large cell in about three oil immersion fields, and a definitely large cell with a slight tendency to bigger cells not infrequently.

+ + = One definitely large cell in every field, with rather large cells frequently seen.

Microcytes. Definite tiny red cells, smaller than fragmented cells

Rare = One or two seen in counting 100 white cells.

Slight + = One seen in about ten oil immersion fields.

+ = One seen in about four such fields.

Fragmented Red Cells. A description of these appears in the text.

Rare = Only occasionally seen.

Slight + = About one in four oil immersion fields.

+ = At least one in two such fields.

+ + = At least one in each such field.

+ + + = More than three in such a field.

+ + + + = Five or six to an oil immersion field, running as high as eleven or twelve to such a field.

Achromia

Slight + = Questionable if achromia is pathological.

+ = Slight but definite achromia.

+ + = A very definite but not marked degree of achromia.

Polychromatophilia.

Rare = Present in less than one red cell in six or seven oil immersion fields.

Slight + = Present in one cell in about six or seven such fields.

+ = Present in at least one cell in two or three such fields.

TABLE I

Examples of Different Degrees of Blood Changes Observed in Trinitrotoluene Workers

Class	Duration of Work in Days	Summary of Symptoms	Webster Test	White Cells: White Count in Thousands	Percentage of Polynuclear Neutrophils	Percentage of Lymphocytes	Percentage of Large Mononuclears	Percentage of Polynuclear Eosinophils	Percentage of Polynuclear Basophils	Abnormalities of Polynuclear Neutrophils	Abnormalities of Large Mononuclears	Red Cells: Red Count in Millions	Variation in Size	Variation in Shape	Macrocytes	Microcytes	Fragmented Cells	Achromia	Polychromatophilia	Stippling	Platelets
I	9	For four days some breathlessness and headache. Two days dizzy with slight tightness in chest and morning nausea. Very slight cyanosis	+	11.3	73	17	9	1	0	+	0	4.7	sl+	0	0	0	0	sl+	sl+	0	N‡
I	60	For past three weeks rash on body. Had slight tightness in chest and headache and abdominal discomfort	+	6.2	48	42	7	3	0	N	N	4.0	sl+	sl+	0	R†	0	0	R	0	+
I	28	No symptoms except for bitter taste	++++	8.0	65	29	5	1	0	N	N	4.5	sl+	0	0	0	R	0	sl+	0	+
II	42	Slight dyspnea for last two days	++	13.0	51	37	3	8	1	N	N	4.8	sl+	0	0	0	R	++	+	0	+
II	60	Rash on forearms for two weeks. Marked bitter taste, slight abdominal discomfort. Lips somewhat blue.	++	6.4	62	25	7	5	1	0	sl+	4.0	++	0	0	R	+	0	++	0	N
II	480	Off and on has had nausea, dizziness, headache, fatigue and tightness in chest; never marked. Slight cyanosis and pallor.	++	14.4	60	38	2	0	0	N	N	4.3	+	0	0	0	sl+	+	+	0	+
III	120	Occasional morning nausea for two weeks, and slight dyspnea. Is slightly cyanotic.	++	13.5	59	31	4	6	0	sl+	N	4.0	++	0	sl+	0	+	+	++	+	sl+
III	21	Symptoms began four days ago. Considerable fatigue, definite dyspnea, sleeplessness, nausea, occasional cramps in legs. Definite cyanosis.	++	9.0	55	38	4	3	0	N	N	4.5	++	sl+	sl+	0	++	++	++	sl+	N
III	35	Shortness of breath since at work. Looks pale and distinctly blue. Slight gastric symptoms.	++	8.8	67	25	7	1	0	N	N	3.9	+	0	sl+	0	++	+	+++	+	+
IV	21	Marked cyanosis with its usual attending symptoms, dyspnea, etc. Sclerotics slightly yellow.	+++	16.0	64	20	14	1	1	+	++	3.8	++	+	+	+	+++	+	++++	++	++
IV	30	Slight headache, considerable cough. Some dyspnea. Some gastric symptoms. Weak knees. Dizziness. Slaty color. Liver felt slightly tender.	+++++	11.0	49	45	4.5	1	0.5	sl+	sl+	3.7	++	0	0	+	+++	+	+++	sl+	+
IV	60	Quite cyanotic and dyspneic, with abdominal symptoms rather marked	++	7.0	70	22	7	1	0	N	N	4.2	++	+	++	0	+++	sl+	+++	+++	sl+

*N—Normal

†R—Rare

‡This case showed four normoblasts per 100 white cells and some Howell-Jolly bodies.

It is felt that the total amount of red cell changes are proportional to the symptoms exhibited in the cases shown in this chart except in the following instances. The first case has rather more and the second case perhaps slightly more symptoms than anticipated from the red cells.

The first case in Class III has rather fewer symptoms than anticipated from the red cell picture, and so has the last case in Class IV.

++ = Present in about one cell to each oil immersion field.
+++ = Present in at least three cells in each oil immersion field.
++++ = Present in at least five cells in each such field.

Stippling.—The pluses under this heading mean that stippled cells occurred half as frequently as did the polychromatophilic cells for the same number of pluses.

Abnormalities of Polynuclear Neutrophils.
+ = About 5 per cent. were in some manner atypical in that they showed abnormally coarse granules, appeared abortive in size, or had a non-lobed nucleus, etc.
++ = About 15 per cent. of the cells were of this character.

Abnormalities of Large Mononuclears.
+ = About half of these cells were atypical.
++ = About 75 per cent. were atypical.

After studying the charts it was found that certain changes in the blood were evidently more important indicators of the amount of damage that had occurred to the hematopoietic system than others. However, it was felt that one should not try to judge hematopoietic injury by any one factor, but by the total degree of blood abnormality. When we separated platelet and white cell abnormalities, particularly changes in the percentage formulas or in absolute numbers, from red cell abnormalities, we found that the degree of the latter varied proportionally with the symptoms presented very much more often than the former. In fact, there was usually a definite relationship between the amount of red cell changes and the symptoms. A glance at Table 1 shows how frequently red cell changes were found, which is in contrast to what was expected from the literature.

Of the 233 cases, a classification based on the total red cell changes was made. This will be discussed before taking up the more detailed features of the red cells. Table 2 summarizes this classification.

Class I.—Fifty-seven cases (24+ per cent. of the series). These cases had very slight or no red cell changes. The changes were less than ++ on any of the red cell features noted in the table except for + on variation in size and on achromia. Forty-two or 73+ per cent. had either minor symptoms or no symptoms. Fifteen or 27− per cent. had relatively more symptoms than the changes in the red cells might indicate, though but six or 10+ per cent. of these had symptoms of a degree that was usual in the milder cases of Class III. Six or 10 per cent. had very clear-cut significant symptoms that were of a degree to be expected in the milder Class IV cases. One of these had the lowest red count of the Class I cases. The symptoms in four of these six cases had come on rather acutely within a few days after beginning work, and it is possible that there had not been time for blood changes to be ex-

TABLE 2

RELATION OF SYMPTOMS TO TOTAL RED CELL ABNORMALITIES

Class	Average Red Count in Millions	Red Cell Abnormalities	Total Number of Cases	Symptoms: Cases with Symptoms of a Degree Proportional to the Total Red Cell Abnormalities	Cases with Symptoms Proportionally Greater than the Total Red Cell Abnormalities: Slightly to Moderately	Cases with Symptoms Proportionally Greater than the Total Red Cell Abnormalities: Distinctly	Cases with Symptoms Proportionally Less than the Total Red Cell Abnormalities: Slightly to Moderately	Cases with Symptoms Proportionally Less than the Total Red Cell Abnormalities: Distinctly
I	4.5	Very slight	57	42	9	6	0	0
II	4.3	Slight	79	60	16	3	0	0
III	3.9	Moderate	64	50	0	0	7	7
IV	3.8	Marked	33	25	0	0	8	0
Percentage of total 233 cases				76−	10+	4	6+	3+

hibited. However, the second most abnormal blood noted in the whole series occurred in a man who had been at work but three days.

Class II.—Seventy-nine cases (33⁻ per cent. of the whole series). All these cases had slight red cell changes of a degree falling between those in Class I and Class III; sixty (75.5 per cent.) had symptoms of a minor degree but rather greater than those in Class I, while nineteen or 24.5 per cent. had rather more symptoms than the others. Fifteen of these nineteen cases, that is 18⁺ per cent. of this class, had symptoms of about the degree usually appearing in the cases with the mildest symptoms in Group III, while three, or 6 per cent. of Class II, were definitely sick, with tenderness in the liver region in two. Their symptoms were about equivalent to those of the cases with the least symptoms in Group IV. Two of these three distinctly sick cases, like the majority of the sickest Class I cases, had been at work but a few days.

Class III.—Sixty-four cases (27⁺ per cent. of the whole series). The blood of this class showed moderate red cell changes. These changes were of about the following degree: + + but less than + + + on some one of the red cell features studied, with a + on at least two others, and a slight + on another. All but fourteen (21.8 per cent.) of these cases had very definite symptoms—some more than others. These fourteen had *fewer* symptoms than the others or than might have been expected from the red cell findings. None had more symptoms than were anticipated from studying the red cells. The usual symptoms in this class of cases included definite cyanosis and dyspnea, as well as any of the symptoms that may be produced by the poison except for those undoubtedly due to liver injury.

Seven of these fourteen cases with fewer symptoms than were anticipated from the blood had distinctly fewer symptoms—symptoms as slight as often occurred in Class I—while the remaining seven had merely somewhat fewer symptoms than the majority of cases in this class. There appeared to be no definite relation between duration of exposure to T.N.T. and absence of symptoms in these cases, though there was more often an indication that such cases had been at work a longer rather than a shorter time, rather than that the opposite was true.

Class IV.—Thirty-three cases (14⁺ per cent. of the whole series). These cases had marked red cell changes. There occurred at least + + + on one of the red cell features, and hence there always occurred at least + + on another, with not less than + on three others. This resulted in meaning nearly always that there were fragmented cells + + +, or polychromatophilia + + +. All of these cases had definite clear-cut symptoms, there frequently being symptoms or signs pointing toward liver injury. Twenty-one had very marked symptoms and were sick. Although four had perhaps, and eight certainly had relatively fewer symptoms than the others, they never had fewer symptoms than those occurring in the more marked cases of Class III, except in two instances. Both of these cases had symptoms as slight as the mildest cases in Class III.

In considering the degree of symptoms and signs presented by each case, relatively more weight was put on symptoms pointing toward toxic action of the poison, such as cyanosis, liver tenderness, dyspnea, pathological fatigue, etc., than upon symptoms and signs suggesting irritation, such as running of the eyes, skin rashes, mild digestive disturbances, etc. The available data concerning the symptoms have in many instances been brief, and the matter of judgment from data is more difficult and not so satisfactory as if one had seen all the cases and made his own notes.

However, in the above classification, it is to be noted that all the cases that had marked red cell changes, had definite clear-cut symptoms, and most of those with moderate red cell changes had definite symptoms. While a few with moderate red cell changes had distinctly fewer symptoms than were expected from the changes in the red cells, none had more symptoms than were expected from the red cells. We feel, therefore, that changes of the degree seen in Class IV and of at least the higher degrees seen in Class III, are to be looked upon as serious, regardless of what symptoms may be presented, both because of the general relationship with symptoms and because blood changes of such an extent are distinctly pathological.

Changes of the degree seen in Class III

as a whole cannot be looked upon as insignificant or harmless, even if there are but minor symptoms. Individuals showing such changes for a short time only will probably nearly always have their hematopoietic functions return to normal relatively rapidly. If, however, such changes persist from constant exposure to a poison, more permanent damage to the hematopoietic system may result so that upon removal from the poison, the blood cannot perhaps ever return to its wholly normal condition, or may do so relatively slowly. Whether such changes in the blood as seen in Class II, persisting for a long period of time, may result in a permanent change, is open to speculation. In Classes I and II we note that, though the majority of the cases had symptoms proportionate to their red cell changes, there were some that had distinctly more symptoms than were to be indicated by the blood. In fact, 4 per cent. of all 233 cases showed distinctly more symptoms than the blood suggested, while 3+ per cent. showed distinctly fewer symptoms than suggested by the blood. It is thus evident that one cannot absolutely rely on the red cells alone to tell the degree of poisoning. It is apparently possible, however, to obtain roughly an index of the degree of poisoning in a large majority of instances from the character of the red cells.

Though data are meagre concerning the changes occurring from time to time in any one case, there are certain observations which show that the degree of red cell changes in Classes I, II and III may remain about the same for at least a period of weeks, and from the clinical history, probably for many months, resulting in a chronic form of blood defect. On the other hand, there are observations to show that such red cell changes as seen in Classes I and II may become of the degree seen in Classes III and IV inside of a period of a few days, so that we have a more acute alteration of the blood. Data show that there is no relation between duration of exposure and red cell changes, for the same mild or severe changes are seen in individuals exposed over a year as in those exposed less than a week. It would seem that the degree of poisoning, and thus the usual associated red cell changes, are dependent particularly upon the amount of T.N.T. entering the body, or upon its concentration in the body. It is also highly probable that an individual's natural susceptibility or his susceptibility because of some evident or latent organic defect, plays a part in the degree of poisoning that occurs.

Before taking up certain detailed features of the red cells, let us note the red counts in these different classes of cases. Counts were not made on all of the 233 cases; the following, however, gives a summary of the red counts which were made.

Class	No. of Cases	Red Cell Counts	
		Average	Extremes
I	25	4,500,000	4,000,000 6,000,000
II	27	4,300,000	4,000,000 6,000,000
III	21	3,900,000	3,200,000 5,000,000
IV	12	3,800,000	3,000,000 4,500,000

It is thus evident, as is to be expected, that usually the greater the red cell changes, the lower the red count.

Observations on the hemoglobin were made only by a Tallquist scale, and we feel that the figures are not at all reliable, not only owing to the method but because of the abnormal character of the hemoglobin in so many cases. Palmer's method for hemoglobin would have been used if opportunity had permitted. It is evident, however, that in many cases the hemoglobin was diminished below normal. This is further shown by the fact that achromia of the red cells frequently occurred, though never to a marked degree.

Grossly the blood frequently appeared very dark, its degree being roughly parallel to the degree of cyanosis. This dark color remained when the blood was absorbed on paper and the blood did not soon turn red. This feature of the blood is in all probability dependent upon the formation of methemoglobin, with probably an admixture of nitric oxide hemoglobin. Studies on the amount and char-

TABLE 3

RELATION OF SYMPTOMS TO NUMBER OF FRAGMENTED RED CELLS

Class	Number of Fragmented Cells	Total Number of Cases	Cases with Symptoms of a Degree Proportional to the Fragmented Cells	Cases with Symptoms Proportionally Greater than the Number of Fragmented Cells		Cases with Symptoms Proportionally Less than the Number of Fragmented Cells
				Slightly to Moderately	Distinctly	
I	0 to rare	92	58	25	9	0
II	sl+ to +	70	47	20	3	0
III	$+^{+}$ to $++^{+}$	45	36	6	0	3
IV	+++ and over	26	21	0	0	2
Percentage of total 233 cases			70+	22−	5+	2+

acter of the abnormal hemoglobin were not made. Another gross feature of the blood was the fact that it frequently appeared thick and sticky, suggesting an increased viscocity. Determinations of the viscosity were begun too late in the field studies to yield definite data.

The detailed study of the red cells showed numerous abnormalities. The most interesting abnormality was the frequent finding in the blood smears of what we believe to be *fragmented* or *fragmenting* red cells, apparently similar to those obtained by special methods from animals by Rous and Robertson (16). These red cells average about half the size of a normal red cell and stain deeper (not polychromatophilic) than the other red cells. They usually appear frayed or irregular, particularly in a portion of their periphery. Clear portions can be seen at times between two darkly staining portions or a pale irregular portion extending from the darker portion. Cells apparently exactly like these are shown in a photomicrograph of the blood from a case of acetanalid poisoning reported by Stengel and White (17). Similar cells have been reported by Warthin (18) in the liver capillaries of a patient dying from dinitrophenol poisoning, but I am not aware of their having been reported in T.N.T. poisoning. Cells like them may be occasionally seen in fixed blood smears from certain unusual clinical cases of anemia, but apparently not in such frequent numbers as in T.N.T. poisoning. Unfixed preparations are much better for studying these cells than fixed preparations.

A classification of the cases was made on the basis of the frequency of these fragmented cells and correlated with the symptoms presented. The results are shown in Table 3.

From this table, it may be seen that the greater the number of fragmented cells, the closer approximation there is to the degree of symptoms. It is significant to note that when they are scant, the symptoms are frequently proportionally greater, and sometimes very distinctly greater; but when the fragmented cells are plentiful, the symptoms are never greater and seldom proportionally less. It seems that those cases where the symptoms are marked and the fragmented cells relatively few are those either with symptoms of brief duration,* or with more chronic intermittent symptoms extending over a rather long period of time. This suggests that in the former instance the cells had not had time to appear, or in the latter, that the condition was one which did not let them appear in large numbers at one time. The clinical data are not detailed enough to draw this conclusion definitely. However, we feel that distinct increases of fragmented cells are to be looked upon as a definite and significant sign of poisoning in these cases. We believe also that these fragmented cells are cells in the process of destruction and that they afford evidence of this form of action of the

*It is to be noted that cases with symptoms of brief duration may have large numbers of fragmented cells.

poison. Destruction of the red cells is usually considered as occurring in the poisoning developing in T.N.T. workers. In view of the rapid anemia frequently seen, with evidence of increased activity of the marrow as shown by the frequent polynuclear leucocytosis, polychromatophilia, and increases of platelets, etc., destruction of red cells practically must occur and must occur rather acutely. It would be interesting to know if individuals showing over + + + increases of fragmented cells actually became more seriously poisoned than the relatively few patients with rather marked symptoms but with few fragmented cells.

Further evidence of red cell destruction in T.N.T. poisoning is perhaps afforded by the frequency of increases of bile pigments in the plasma. This has been noted by Panton, and I have observed the same. Bile, however, was very rarely found in the urine. Careful studies on the blood pigment metabolism in correlation with the numbers of fragmented cells would be interesting. I have not enough data to state that the bile pigments in the plasma usually ran proportional to the fragmented cells, but it would seem that this might be true. Still further evidence of red cell destruction is afforded by what seems to be abnormal blood pigments excreted in the urine in generous amounts. It is not infrequent to find dark urines, and sometimes urines as dark as port wine, more particularly in the sicker cases. This color is evidently not dependent upon bile, nor wholly upon the excreted or altered T.N.T., but probably at least somewhat dependent upon some blood-derived pigment. It has not been possible to determine what the substance (or substances) is that causes these dark urines.

Having considered the red cell abnormalities that appear to indicate destruction, let us consider the other abnormalities which occurred in these cases. These include the usual changes seen with a so-called secondary anemia with evidence of regeneration. The frequency of polychromatophilia of the red cells in this series of cases was striking, and it is difficult to understand why it has been reported before only as an unusual finding. It is possible that this is because others have used unsatisfactory blood stain. During the study of this series of blood smears, I have been much impressed—even more so than formerly—with the necessity of having good smears and good stains to study the detailed characters of the blood.

Polychromatophilia occurred in 83 per cent. of all the 233 cases, not including those cases where it occurred only "rarely," there being 51 (21 + per cent.) cases with a degree of polychromatophilia defined as + + or over, seven of which, or 3 per cent. of all the cases, had + + + + or over. The intensity of the polychromatophilia varied so that in some instances it was usually light with an occasionally darker cell, while in other cases all the polychromatophilic cells were distinctly dark.

The frequency of fragmented cells was compared with the frequency of polychromatophilia, and it was found that of 162 cases having + numbers of fragmented cells or less, 59 per cent. had an approximately similar amount of polychromatophilia; 29 per cent. had proportionally more polychromatophilia; while 2 per cent. had proportionally less. On the contrary, of 71 cases having fragmented cells + + or over, about 80 per cent. had a proportional amount of polychromatophilia, and 5 per cent. had proportionally more, while 15 per cent. had proportionally less. From this it is to be seen that polychromatophilic cells apparently appear in the blood sooner or with greater ease than the fragmented cells, and that when the conditions occur that cause many fragmented cells, the degree of polychromatophilia not infrequently appears to be proportionally less. It seems that polychromatophilia is one of the earliest and most constant blood changes seen in workers with T.N.T., and not infrequently occurs to a marked degree.

An attempt was made to compare the degree of polychromatophilia with the symptoms presented but the agreement found was not so close as when the total red cell changes or the fragmented cells were compared with symptoms.

The reticulated red cells are to be looked upon as young cells, and increases in the numbers (normally about 0.7 per cent.) are to be looked upon as evidence of increased activity of the marrow. These cells are demonstrable in fresh preparations stained with brilliant cresyl blue.

The reticulated red cells were studied in thirty-five trinitrotoluene workers, particularly by Messrs. T. J. Putnam and W. Herman of the Harvard Medical School and were found to be increased in many instances, the greatest numbers being found in cases where one expected the greatest evidence of marrow activity. Frequently, about 3 to 4 per cent. were found; at times about 8 to 10 per cent. These cells can probably be taken as the best single indicator of the degree of rapidly increased red-cell activity that we have. Polychromatophilia also may indicate this, but nearly always there will be proportionally more reticulated cells than there is polychromatophilia. These observations of the numbers of the reticulated cells give one a quick and clear-cut additional method of judging the degree of blood abnormality present, particularly giving evidence of the rate and amount of red cell regeneration.

Stippling occurred in sixty-seven cases or 24 per cent. of all the 233 cases. In thirty-five it was of a degree defined as over +, and in thirty-two less than this. It was always associated with some degree of polychromatophilia. Usually stippling was of a fine variety, but sometimes of a distinctly coarse type. The coarse type was generally found in the cases with more marked total blood changes.

Twenty cases (8.5 per cent.) showed Howell-Jolly bodies. Eleven of these occurred in Class IV (based upon total red cell changes), while the remaining nine occurred in Class III. All were associated with over + + polychromatophilia except two. These bodies occurred but rarely in four cases, and in plentiful numbers in only two. They practically always occurred in polychromatophilic cells. There were plenty of cases with a + + amount of polychromatophilia that showed no Howell-Jolly bodies, and there were some cases with + + + + polychromatophilia without these bodies.

In six cases (2.5 per cent.) normoblasts were found, all being distinctly sick cases. In the most striking case of the series, there were found as many as eighteen blasts during the counting of 100 white cells. In but one other case did blasts occur at all commonly: about nine per hundred white cells. In the other four cases, only one or two were seen in the smears.

At least a slight pathological variation in the size of the red cells occurred in practically every case. Thirty-five (15 + per cent.) showed + + variation, while but three (1 + per cent.) showed + + + variation in size. Many fewer cases showed a definite abnormal variation in shape of the red cells, if we exclude fragmented cells. The red cells of none of the cases showed what might be termed a marked or moderate variation in shape.

Under the definitions of the + signs, it has been stated that the macrocytes referred to in this study were usually cells somewhat larger than normal, and that rarely was an extremely large red cell seen. When found these larger red cells were nearly always round, and were not the large, oval, deeply-staining macrocytes seen in pernicious anemia. In some cases there seemed to be a tendency toward a slight macrocytosis. There was no relation between this finding and the duration of the individual's exposure to the poison. These larger cells occurred to a degree of slight + in thirty-nine cases (16 + per cent.); + in seven cases (2 + per cent.); over + in six cases (2 + per cent.). Seventy-five per cent. of the sickest cases showed such cells in a degree of over +. It is felt that these larger cells are simply associated with other cell changes and have no significance in regard to the degree of poisoning.

True microcytes were relatively rare even in spite of the frequency of the fragmented cells described. Though commoner in the bloods with many fragmented cells, they never occurred at all plentifully. In many instances the number of microcytes was found to be the same, whether there were many or few fragmented cells. Twenty-three cases (9 + per cent.) showed microcytes above the degree noted as rare, while twenty-five (10 + per cent.) showed them merely to a degree noted as rare.

From these studies of the red cells, it is to be seen that we have evidence not only of red cell destruction but of active red cell regeneration, though the sicker the cases the greater the anemia, presumably because the formation is unable to keep pace with the destruction.

In judging the blood abnormality and its significance in a given case, it is of course important to consider all factors together

rather than one alone. The white cells, however, as a rule did not, upon one observation, yield such significant information as did the red cells. Because aplasia of the marrow is one of the severe effects of T.N.T. poisoning, one would naturally in studying the white cells look for a relative lymphocytosis, especially when there is a leucopenia, as an early sign of this condition. With a diminished output of the polynuclear cells from the marrow and at the same time the lymphocytic-forming tissue being unaffected, lymphocytes will occur in the blood in the same numbers as before the marrow decreased its cellular output. The question of lymphocytosis was studied in the series of cases on account of this fact and also because lymphocytosis is reported as a significant sign of poisoning in T.N.T. workers, and as frequently occurring in the severest cases of T.N.T. poisoning. It is often difficult to determine whether an individual has a pathological lymphocytosis dependent upon a poison without knowing his lymphocyte percentage before exposure to the poison. Many conditions cause a slight grade of lymphocytosis, and many individuals habitually have more lymphocytes than others, so that normally these cells vary from about 20 to 40 per cent. With this question of lymphocytosis particularly in mind, we shall proceed to a consideration of the white corpuscles in our 233 cases.

The total white count was frequently increased above normal, as has been stated by others. However, there appeared to be no relation between the white count and the symptoms that the cases exhibited, nor in the amount of red-cell changes. The following figures show the average white counts in the cases classed according to the total red-cell changes:

Class	No. of Cases	White Count
I	37	8,400
II	47	9,000
III	41	8,300
IV	12	8,400

Essentially the same average figures are obtained when the cases are classed into four groups purely on the symptoms presented.

Of all 137 counts, there were two below 5,000; one of 4,500, and one of 4,800; one with the lymphocytes 48 per cent., the other with the lymphocytes 22 per cent.; both with moderate symptoms and red-cell changes.

There were seventeen cases (12+ per cent.) with counts above 12,000, two of which were above 15,000; one of 17,000; and one of 23,000. If the white count was definitely elevated over 10,000, there was usually a distinctly high polynuclear percentage, but this was by no means always so. The lymphocytes when increased were usually associated with lower rather than higher counts, but there were numerous definite exceptions. Polynuclear leucocytosis occurred in as great a degree in cases with marked symptoms as in cases with insignificant symptoms. Practically the same figures were obtained for the percentage of polynuclears for four groups of cases when based upon the degree of symptoms presented as when based upon red-cell changes. These average percentages are: Class I, 62 per cent.; Class II, 60 per cent.; Class III, 57 per cent.; Class IV, 56 per cent.

The lymphocyte averages for these groups were proportional; that is, a greater percentage of them occurred in Class IV than in Class I. It thus may be seen that on an average the sicker cases or those with the most red-cell changes averaged slightly fewer polynuclear cells and slightly more lymphocytes than the cases with minor symptoms and very slight red-cell changes. However, there are among forty-three cases (14+ per cent. of the series) with a lymphocyte count of over 40 per cent. and with a low polynuclear count, about 70 per cent., with definitely significant toxic symptoms, and but about 30 per cent. with mild symptoms. There were twenty cases (8.5 per cent. of the series) with lymphocytes between 40 and 42 per cent.; fourteen with over 45 per cent., of which nine had over 50 and under 56 per cent. Patients with slight, moderate, and marked symptoms occurred even among the cases with the greatest numbers of lymphocytes. Only two of the nine cases with over 50 per cent. of lymphocytes had slight symptoms, and yet only two had very marked symptoms. The figures for the absolute numbers of white cells revealed nothing unexpected. However, of

ten cases with the white count 6,000 or below and the lymphocytes over 42 per cent., 80 per cent. showed very definite symptoms of poisoning, though often not marked; none showed minor symptoms only.

The few available observations at hand show that with a gradual increase of symptoms, there is usually an increase of lymphocytes, but numerous observations show that an individual may become distinctly poisoned without their number reaching 40 per cent., and that cases of definite poisoning and cases with moderate symptoms often occur with a high polynuclear count. This, presumably at a later date and if the marrow fails, may be substituted by a low polynuclear count and a high lymphocyte count. There are also observations at hand to show that the lympocytes may remain high for at least some weeks while exposure to T.N.T. is continued, without there being any increase of symptoms or further reduction of the red count.

Not only the total number of lymphocytes but also their character was considered. Usually with increased numbers of lymphocytes, there occurred an increase of both small and large forms, but not infrequently the large ones would be proportionally more increased than the small. This was particularly true in the series of blood smears from individuals working at a plant in Wisconsin. In the blood of all the cases from this plant, it seemed as if the lymphocytes averaged rather higher than from the other plants, and that larger lymphocytes occurred more frequently. This may be dependent upon the geographical location of the plant as compared with the others, which were on the Atlantic slope. Indeed, it has been suggested that in the Wisconsin district individuals are apt to have normally more lymphocytes than on the Atlantic slope.

Some cases had rather small abortive-looking lymphocytes, often with short tails and more granules than normal, others had atypical large lymphocytes at times. Perhaps such cells are to be looked upon as occurring with an increased production of lymphocytes. We feel from a study of the blood and symptoms that when a lymphocytosis occurred containing a considerable number of smaller cells and very few or no large lymphocytes, it was apt to be in a patient distinctly poisoned. In the few cases with a low white count and high lymphocyte count, the majority of the lymphocytes were small normal-looking cells.

From what has been said regarding increases of lymphocytes, it may be noted that lymphocytosis *per se*, as an isolated observation, does not give us definite information concerning an individual's condition or his symptoms. It is, however, more apt to be associated with clear-cut symptoms of poisoning than with slight symptoms. Lymphocytosis is to be looked upon as a distinct abnormality and probably one of an undesirable type. Although some cases may continue for weeks with a lymphocytosis, and others have a lymphocytosis and only mild symptoms, we cannot help feeling that such cases should be looked upon as undesirable risks unless there be other reasons than poisoning to explain the lymphocytosis. The presence of lymphocytosis with increased counts or an absolute increase of lymphocytes suggests that a slight actual stimulation of these cells may occur from the poisoning. At times their character also suggests this. Absolute increase of lymphocytes would probably indicate a less serious form of blood alteration than a relative lymphocytosis associated with a polynuclear decrease, as occurs with an aplasia of the marrow. A lymphocytosis in the presence of a leucopenia should be undoubtedly regarded as serious, and probably toxic cases with a lymphocytosis should be considered more serious than those with a polynuclear leucocytosis.

It would seem from our data that the progression of changes in the leucocyte and lymphocyte formula is, first, an increased white count with a polynuclear leucocytosis, followed by a falling count probably with absolute increase of lymphocytes. This may then be followed by a leucopenia with diminished polynuclears and relatively increased lymphocytes.

Severe poisoning, however, may occur at any time during such a curve. One cannot, therefore, say that if the lymphocytes are not increased significant poisoning is not threatening or occurring. One should, however, feel that if the lymphocytes are over 40 or 42 per cent. it is an undesirable sign, but unless there is a leucopenia this does not necessarily indicate that significant poisoning is occurring or will occur.

A few of the cases with more symptoms

than the red-cell changes suggested, had increased lymphocytes; many more did not. One might appropriately ask, was the absence of red-cell changes in such cases dependent upon an aplasia that had caused the lymphocytosis? This was probably not the case because of the high level of the red count and its persistence in some of these patients. This simply serves to emphasize that, though blood changes, particularly red-cell changes, will usually indicate the degree of poisoning, one must not attempt to judge the degree except from the blood as a whole.

We have still to consider the other white corpuscles, the various types of large mononuclear cells, as well as the eosinophil and basophil polynuclear cells. For simplicity, all forms of large mononuclear cells, not including large lymphocytes, have been classed together in the table. However, in studying these cells, the different types and forms were noted. Usually, normal large mononuclears, seldom of the so-called transitional cell type, were the cells present, though not infrequently such cells were of an abnormal and atypical appearance. They were often vacuolated, with irregular nuclei, and often had very dark finely granular protoplasm. Sometimes they were abnormally large, and at times abnormally small. Often it was impossible to classify the cells definitely. Some probably represented cells from the marrow hastily thrown into the circulation in response to an increased demand on the hematopoietic organs, while others, especially where the lymphocyte percentage was high, were probably atypical lymphocytes.

The occurrence of atypical mononuclear cells was noted in twenty-four cases (10^+ per cent.), but it did not seem to occur in any particular class of cases when grouped according to symptoms. These cells were particularly apt to occur when the polynuclears also exhibited some degree of abnormality, and were more apt to occur when the large mononuclear count was high rather than low. The polynuclear abnormalities were never very marked; thirty-three cases (14 per cent.) showed polynuclears which sometimes had an abnormally coarsely granular protoplasm, and sometimes had a pycnotic or non-lobed nucleus. Such cells occurred more usually when the polynuclears were either decidedly increased or decidedly diminished. This suggests that such abnormalities as the polynuclears and mononuclears exhibited occurred when the marrow was making a rather marked effort to keep its output up to the stimulus given. The fact that, in a few instances, real myelocytes occurred (never over 2 per cent. of the white cells) associated with abnormalities of the mononuclears and polynuclears suggests the same hypothesis. Thus, in judging the degree of abnormality of the blood, abnormal white cells should be noted in the study and taken into consideration when deciding upon the total amount of blood abnormality present.

There occurred not infrequently a higher percentage of mononuclears than normal; twenty-five cases (10^+ per cent.) had over 10 per cent., and five had over 14 per cent. but only one as high as 20 per cent. Such increases, however, not infrequently occur in anemia and in blood disturbances. No special significance in regard to poisoning with T.N.T. can, therefore, be attributed to an increase of mononuclear cells.

In this series of cases, as in other reported cases, a slight degree of eosinophilia was not infrequent. Five per cent. or over of eosinophil cells were found in twenty-five cases, three of which had over 10 per cent., the highest being 15 per cent. Eosinophilia in certain conditions and in certain anemias, not dependent upon specific conditions known to cause eosinophilia, is often looked upon as a good prognostic sign and evidence of good marrow regeneration. In view of this, it is interesting to note that 17 per cent. of the 136 cases with few red-cell changes showed an eosinophilia of over 5 per cent., while but 5 per cent. of the ninety-seven cases with more marked red-cell changes showed an eosinophilia of this grade. Though cases of all degrees of poisoning showed no eosinophil cells, it seemed to be more common for the cases with the more marked red-cell changes or with marked symptoms, to have no eosinophiles than for the cases with the lesser red-cell changes or with lesser symptoms. We, therefore, feel that eosinophilia in individuals exposed to T.N.T., provided other causes of eosinophilia are not present, is to be looked upon as a blood abnormality due to their work, but that it is to be taken as suggesting good rather than poor marrow activity, such as lymphocytosis

may suggest. In the cases with over 5 per cent. eosinophil cells, the lymphocytes were never over 40 per cent.; usually their percentage number was low. We at first thought that perhaps the skin rashes were the cause of the eosinophilia, in view of its frequency from various dermatoses. The case with the highest count did have a marked T.N.T. dermatitis, but further analysis of the data showed numerous cases that had no skin eruption but did have eosinophilia. The precise cause for the eosinophilia is not known.

The basophil polynuclear cells in thirteen cases (5+ per cent.) were 3 per cent.; in many cases none were seen. Evidently no definite abnormality of their numbers or characters occurred. There was also no definite relation between their numbers and the numbers of eosinophil cells.

The third formed elements of the blood, the blood platelets, were studied particularly in the fixed smears, and, in a few instances, in fresh cresyl blue preparations. Counts were not made. In order to estimate platelets satisfactorily in smears, it is necessary to have excellently made, well-stained cover-glass smears, rather than smears made on slides, because the latter method is much more apt to allow the platelets to be clumped in the edges of the preparation. Evidence of diminished numbers of platelets except in good smears is of no value. Evidence of normal numbers in not wholly satisfactory preparations rules out the possibility of diminished numbers, but they may be, of course, actually increased. Owing to the fact that many of the smears did not fulfil the ideal conditions for studying platelets, their numbers could not be judged in all the 233 cases. Their numbers were estimated in about 100 cases, and in only two were they considered below normal, and then only slightly. Diminished platelets are found to a marked degree in advanced aplastic anemia, and in this condition are evidence of a decreased output from the megakaryocytes of the marrow. In both the T.N.T. cases in which the platelets were diminished, the lymphocytes were high. Thus, we feel that diminished platelets should certainly be regarded as evidence of a severe effect upon the marrow. In all the other cases, the platelets never occurred in less than normal numbers. In many instances they were slightly increased, and not uncommonly considerably increased. With increases of platelets, the lymphocytes were sometimes increased, but more usually, the considerable increases were seen with a polynuclear leucocytosis. Increased numbers of platelets indicate further evidence of increased marrow activity occurring as the result of the poisoning in T.N.T. workers. Their diminution also gives us further evidence of diminished marrow activity occurring in certain instances following an increased activity. The detailed characters of the platelets in these cases were not sufficiently abnormal to warrant discussion here.

Webster's (6) qualitative test for changed T.N.T. in the urine was done on most of the 233 cases. This test has been advocated for determining the degree of poisoning. It probably is of definite value in judging the condition of workers. I will not discuss its merits or demerits, but I believe more information is to be obtained from one blood examination than from one Webster test, or even from a few such tests. The data were studied for the relationship between the blood abnormality and the intensity of the Webster test. Suffice it to say, that cases with marked blood changes usually showed a more intense Webster test than others. But some of the cases with marked blood changes showed less intense Webster tests than other cases with not even moderate blood changes and without any definitely significant signs or symptoms of poisoning. With the lesser degrees of positive Webster tests, no relationship between the test and the blood picture or symptoms could be determined.

The question of duration of exposure to T.N.T. and its relationship to blood defect was referred to in the discussion of the red cells. It may be added here that, when either considering the blood as a whole or in studying any of its features, no relation could be found between simple duration of exposure and the character of the blood picture. To be sure, poisoning was more apt to occur within a few weeks of beginning work than in a few months, but this was more dependent upon the amount of T.N.T. absorbed, the individual's susceptibility, etc., than upon simple duration of exposure. However, it must be recalled that a blood defect of a mild degree kept present for a long time from constant exposure to small amounts of a poison, may

result in a more permanent damage than the same abnormality present for but a short time.

Nothing more than could be learned from symptoms was learned from studying the relationship between the different types of work the men did and their blood picture. The types of work where the greatest exposure and absorption of poison occurred led to most of the cases of poisoning, and thus usually to the greatest number of cases with definite blood changes.

SUMMARY AND CONCLUSIONS

From these studies of the blood of 233 men, essentially unselected, working in all types of processes occurring in the making of T.N.T. and in its use in filling shells, it is evident that blood abnormality frequently occurs, even in the most minor grades of poisoning. A single indicator of the frequency of blood abnormality is to be found in the fact that 83 per cent. of the individuals studied showed at least as many polychromatophilic cells as one in every six or seven oil immersion fields; more than one such cell to a field frequently occurred, and sometimes as many as five or six. This is not in accordance with the literature, and may be dependent upon some difference in the conditions under which the different individuals, reported on here or elsewhere, worked.

Altered hemoglobin undoubtedly occurs in these individuals, as determined from the gross character of the blood, and there may be an increased blood viscosity. The altered hemoglobin is probably in the nature of varying mixtures of methemoglobin and nitric oxide hemoglobin. The literature gives little absolute proof of this, and the present study furnishes no further information.

The blood changes taken as a whole in the majority of cases studied yield significant information concerning the condition of the worker.

The total red-cell abnormalities usually appear to run roughly parallel to the degree of symptoms, but in some instances marked symptoms may occur and the red-cell and total blood abnormalities be slight. However, marked red-cell changes appear to be always associated with symptoms of at least a moderate degree, and usually with symptoms of a marked degree.

The nature of the blood changes, besides alteration of the hemoglobin, are of at least two types: destructive action of the red cells with increased marrow activity, later followed in some instances by marrow inactivity. It is rare to find definite evidence of aplasia, while cases showing symptoms suggesting toxic liver changes, together with blood abnormalities indicating red-cell destruction and marrow activity, are distinctly common. Thus toxic jaundice is the most common form of severe poisoning to guard against.

We believe that evidence of red-cell destruction is to be found in the histological examination of the blood especially in the finding of fragmented or fragmenting cells. Other evidence of blood destruction has been discussed. All the cases with large numbers of fragmented cells showed signs of being distinctly sick, often they were slightly jaundiced, without bile in their urine. The data show that it was decidedly unusual to have definitely sick cases with but few of these cells. Perhaps the absence of fragmented cells in the blood of individuals with definite symptoms of poisoning may be explained on the supposition that the rate or degree of destruction was not enough to allow such cells to appear in the circulation. It would seem that when they occurred in the circulation, destruction was taking place faster than the liver, or perhaps other organs, could take care of the destroyed blood.

Evidence of increased blood formation is plentiful. The probable stimulus to this is the increased oxygen-want caused by the altered hemoglobin, as well as the products of blood destruction, with later anemia itself.

There is some evidence to suggest that with very minimal amounts of T.N.T. entering the body, the red cells, polynuclears, and platelets, the three chief formed elements originating in the marrow, all may be maintained at the same time at a slightly higher level than normal. The possibility of increased red counts is suggested by Panton (7), and certain of our cases with minor symptoms had high counts (6,000,000), with increases of young red cells as well as increases of polynuclears and platelets. Such high counts did not occur in definitely cyanotic individuals. This stage of stimulation in which all the marrow elements are kept above normal, of course may not occur if the amount of poisoning

or blood destruction is too great to permit it.

When red-cell destruction exceeds formation, anemia ensues. This is of the so-called secondary type. Though hemoglobin estimations were not satisfactorily made, there was evidently often a distinct reduction, probably relatively more than the reduction of the red cells. The degree of the anemia runs parallel with the degree of red-cell changes. The average red count in the cases with the most marked blood abnormalities was 3,800,000. In the presence of definite anemia, as well as before the red counts are significantly reduced, there is a great effort on the part of the marrow to regenerate blood, as evidenced in the peripheral blood by the great frequency of polychromatophilia, fine stippling, reticulated cells, variations in sizes of the cells, etc. This is also shown by the frequency of elevated white counts, with increases of polynuclears, and probably by frequent increases of eosinophils to over 5 per cent. Evidence of the activity of the megakaryocytes of the marrow is seen in increases of platelets. Varying conditions will, of course, give varying blood pictures of these different elements. At times an unusually marked strain appears to be placed on the marrow, so that what has been termed (19) a lowered marrow threshold occurs, as evidenced in the peripheral blood by the occurrence of blasts, Howell-Jolly bodies, and perhaps atypical mononuclear cells and abnormal appearing polynuclears.

Evidence of the marrow's failing to act is probably first seen in relative increases of lymphocytes with absolute diminution of the polynuclears. It is suggested that a stage of stimulation of the lymphocytes occurs from this poison. Lymphocytosis *per se* should be looked upon as a distinct abnormality, but apparently not necessarily as one that indicates something certainly serious unless there is a leucopenia also. Individuals exhibiting such a change, however, should be carefully watched, even if red-cell changes, symptoms, etc., do not indicate any significant poisoning. Further evidence of failure of the marrow is that to be found in diminution of the platelets. This, associated with absolute diminution of the polynuclears, is certainly to be looked upon as evidence of failure of the marrow. At the time when lessened activity of the platelet and white-cell elements occurs in the marrow, the red-cell elements still show marked activity. At a later time, with definite aplasia, which did not occur in any of the cases of this series, the red-cell elements will probably show little or no activity.

It is important to note that definite poisoning, severe enough to make the individual actually sick, usually occurs with definite changes in the red cells and seldom occurs with but slight red-cell changes. On the contrary, poisoning may occur with about equal frequency with any combination of white-cell formula, though the lymphocytes may average slightly higher in such instances. Thus, more information concerning the worker's condition is to be derived from the red cells than from the white cells, though under certain circumstances as described, the white cells may yield some important information.

There is plenty of evidence at hand to show that if the individuals are removed from the poison when they have moderate symptoms and blood changes, the symptoms will disappear and the blood improve. Satisfactory data on the rate of the return to normal or to a definite percentage of normal, are not available. However, it is to be noted that removal from the poison may occur too late—the trap be sprung too far—so that the symptoms progress and fatal anemia or toxic jaundice ensues.

We feel that blood changes of the more marked degrees described should always indicate too severe a poisoning for an individual to be permitted to continue his given type of work, at least for the time being. Such changes occurring clinically would not be treated as insignificant. We also feel that it cannot be considered wise to allow an individual showing a moderate but a persistent increased activity of his marrow, in the presence of anemia and blood destruction, to continue work for any length of time without having him run a risk of damaging his hematopoietic system to such a degree that complete recovery would be difficult or perhaps impossible. It is, however, to be noted, that the duration of work shows no definite relation to the types of blood changes seen, and that blood changes are probably dependent upon the dosage of T.N.T. received and the individual's susceptibility rather than upon the time of exposure to the poison.

With any evidence of failure of the white cell or platelet elements of the marrow, an individual should undoubtedly be removed from his work, but evidence of this based on lymphocytosis *per se* should be carefully judged before considering it as a definitely serious sign.

It is to be understood that blood examinations alone should not be the only criteria on which to decide whether an individual should be permitted to continue his given job or not. Such decisions should be made on frequent careful clinical observations of symptoms and signs, supplemented by blood examinations and probably by Webster tests.

The blood findings will serve, when carefully considered, as a helpful guide, and will sometimes be more valuable than symptoms; though in a few instances, blood findings will apparently give no help toward indicating a rather definite degree of poisoning.

Studies upon industrial conditions, especially the poisonings, may help us to understand further various clinical conditions which they simulate in some manner. It is rather to be expected that observations, if they can be controlled, on the pathological process involved in the various poisonings in man, will yield us more valuable information than studying such processes by various poisons in animals.

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The Health Officer. By Frank Overton, M.D., D.P.H., Sanitary Supervisor, New York State Department of Health; and Willard J. Denno, M.D., D.P.H., Medical Director Standard Oil Company, New York. Cloth. Pp. 512, with illustrations. Philadelphia: W. B. Saunders Company, 1919.

At the present time one of the big needs of public health in this country is a large body of trained health officers. It is, of course, quite impossible to expect that the demand shall be met in the very near future, for the demand is greatly in excess of the supply and the time necessary to produce a trained man is by no means short. Many practicing physicians have entered the field of public health administration either on part or on full time, and this has helped considerably in meeting the need. The curriculum of the medical college is not designed primarily for the purpose of producing public health officers, and because of this the training of the medical man falls short of the demands made by public health work.

For this reason we are at this time particularly fortunate in having a book, *The Health Officer*, by Frank Overton and Willard J. Denno, written for the purpose of assisting the health officer in his everyday duties. The authors of this book have been engaged in public health work for many years, mainly in connection with the New York State Department of Health, and they therefore write from first-hand experience.

The book, which consists of forty-four chapters, starts with a consideration of the organization and powers of the health department, and then turns to the question of the health officer himself, his contact with the public and with the physician. Next follows several chapters devoted to a consideration of records and reports, standard procedures, and the local sanitary code. A very interesting chapter then follows on the subject of epidemiology. The management of communicable disease is followed by a series of chapters dealing with the etiology, the symptomatology, and the mode of transmission of the various diseases, laboratory methods of diagnosis and procedure for the care of cases being given. In this portion of the book the various agencies by means of which disease is spread are depicted by a series of drawings showing the path of the causative agent in producing fresh cases. These drawings serve most admirably to clarify any vague ideas on the subject of transmission of disease. Another chapter, excellently written and of considerable value to the health officer in his daily work, is that dealing with *Nuisances*. Next consideration is given to some of the sanitary problems, such as the *Disposal of Household Wastes*, *Sewage Disposal*, *Water Supplies*, and *Ventilation*. The book closes with chapters on *Industrial Hygiene* and *Life Extension*.

This book is a well-rounded presentation of the solution of the health officer's problems; to him it should render valuable assistance in the pursuit of his everyday duties. It is to be especially recommended to the part-time workers and to students in the field of public health administration. —*Leonard Greenburg.*

The Redemption of the Disabled. A Study of Programmes of Rehabilitation for the Disabled of War and Industry. By Garrard Harris, of the Research Division, Federal Board for Vocational Education. With an introductory chapter by Frank Billings, Colonel, Medical Corps, United States Army; Chief of the Division of Physical Reconstruction, Office of the Surgeon-General; and a foreword by Charles A. Prosser, Director of the Federal Board for Vocational Education. Edited by Francis G. Wickware. Pp. 308 and index with illustrations. New York: D. Appleton and Company, 1919.

The methods adopted for the physical reconstruction of disabled American soldiers were formulated largely upon the experience of the medical departments of the allied armies.

Rehabilitation is not charity; it is the new conception of national duty toward the wounded and disabled. The welfare of wounded men is insured only by economic rehabilitation, not by pensions. The war has taught us that disabled men are so thoroughly worth saving that all democratic countries are now turning their attention to the vocational rehabilitation of those who have been disabled by industrial accidents. The evolution of systems for pensioning and rehabilitating disabled men is dealt with separately for each nation, or group of nations, as follows: Belgium; France; England; Central Empires; Canada; Australia, New Zealand, South Africa, India; Italy; America. In January, 1918, the work of reconstruction was no longer considered in this country a military function, and the Secretary of War called a conference of all the organizations and individuals interested in the problem to determine upon a national program.

From the moment the patient has recovered from the first shock of injury, it must be impressed upon him that he must start to prepare himself for civilian usefulness. All careers are open to the disabled man. Whatever is best for that man, whatever affords him the greatest opportunity for civilian usefulness, that training he shall have. The fact that each man presents a different problem renders necessary a system of instruction in which small groups of students are handled. A systematic record of each man's success or failure after placement provides data for perfecting the scheme of rehabilitation.

Employers must be convinced that a re-trained man is not necessarily deficient in his work, and that the employment of such a man is not an act of charity. When we consider how few workmen are using their faculties to their utmost capacity, and that most trades are highly specialized operations requiring the use of only a few muscles, we may better appreciate the great possibilities of reconstruction. Cases of men earning far higher wages than before injury are very numerous.

The success of the program is largely dependent upon the active and sustained interest of the public. A man who resists reeducation on the ground that he has done his duty may be compelled by the force of public opinion to adopt that course which is best for himself and his community.

This vast and carefully thought-out organization is not to be dissolved as soon as it has accomplished the task for which it was formed. It will be devoted to the rescue and vocational rehabilitation of those victims of industrial processes who otherwise would remain human wrecks and economic burdens. With this project in view, a measure has been introduced in Congress, providing for an annual appropriation to the states for the purpose of co-operating with them in the maintenance of vocational rehabilitation. With the exception of a few experiments by private agencies, no provision has ever been made in this country for re-training and placing industrially handicapped persons.— *L. A. Shaw.*

COMING MEETINGS

NATIONAL SAFETY COUNCIL

An entire general session and two sectional meetings of the Eighth Annual Safety Congress of the National Safety Council which is to be held at Cleveland, Ohio, October 1 to 4, inclusive, will be devoted to discussions of health service in connection with organized accident prevention work.

The program of the congress, just issued, lists 160 speakers, including some of the men most prominent in the practice of industrial medicine. It is expected that more than 3,000 safety engineers, industrial physicians, plant managers and others interested or actively engaged in the work of accident prevention will attend the congress.

Dr. Charles A. Lauffer, Medical Director of the Westinghouse Electric and Manufacturing Company, will preside at the General Health Session on the afternoon of October 3 in the ballroom of the Hotel Statler at Cleveland, and at the Health Section meetings during the mornings of October 3 and 4.

While not generally known, it is a fact that during the nineteen months of our participation in the war with Germany the casualties from accidents in peaceful America were more than twice as great as the casualties among the American troops in France. The statistics of the United States Census show that more than 70,000 persons die each year as the result of accidents in America. It is estimated that 20,000 of these deaths are caused by industrial accidents and 50,000 by accidents in the streets and homes.

It has been the experience of men and women engaged in organized accident prevention work that a large number of the deaths attributed to accidents result only indirectly from accidents and more directly from causes that can be eliminated by health education. The National Safety Council and the 3,800 industrial concerns included in its membership are, therefore, giving more and more attention to health education and health service in the war on accidents.

The programs of the Health Service Section and of the General Health Session of the Eighth Annual Safety Congress are given below.

Health Service Section

Friday Morning, October 3, 9:30 o'clock

South Foyer, Mezzanine Floor

Chairman, Dr. Chas. A. Lauffer,
Medical Director, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Vice-Chairman, F. H. Elam,
American Steel Foundries, Chicago

Secretary, Dr. C. P. Selby
Formerly, Consulting Hygienist, U. S. Public Health Service, Washington, D. C.

PROGRAM (First Session)

1. Report of Chairman.
2. Report of Secretary.
3. Reports of Committees.
4. Appointment of Nominating Committee.
5. Addresses:

9:30 a.m.

I. Industrial Health Hazards.

Dr. C. A. Lauffer, Medical Director, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Discussion by Representative of National Tuberculosis Association.

10:15 a.m.

II. The Subnormal Worker (Pathological).

Dr. Alfred Stengel, Professor of Medicine, University of Pennsylvania, Philadelphia, Pa.

Discussion by Dr. F. E. Schubmehl, General Electric Company, West Lynn, Mass.

11:00 a.m.

III. Industrial Dermatoses (Sources, Types, Control)

Dr. Wm. Allen Pusey, Chicago.

Discussion by Dr. John G. Burke, Jenkins Arcade, Pittsburgh, Pa.

11:30 a.m.

IV. Bad Teeth and Fatigue.

Dr. Weston A. Price, President of the Research Institute of the National Dental Association, Cleveland, Ohio.

Discussion by Dr. H. M. Brewer, Dental Dispensary, National Cash Register Company, Dayton, Ohio.

Saturday Morning, October 4, 9:30 o'clock

South Foyer, Mezzanine Floor

PROGRAM (Second Session)

1. Report of Nominating Committee.
2. Addresses:

I. Malingering, Involving the Problem of Getting the Sick or Injured Employee Back to Work.

Dr. Judson C. Fisher, Chief Medical Examiner, Globe Indemnity Company, New York.

Discussion by Geo. P. Hambrecht, Chairman, Industrial Commission of Wisconsin, Madison, Wis.

II. The Treatment of Burns.

Dr. W. I. Clark, Norton Company, Worcester, Mass.
Discussion by Dr. A. W. Colcord, Carnegie Steel Company, Clairton, Pa.

III. What the War Has Taught Us in Surgery.

Dr. Geo. W. Crile, Cleveland, Ohio.
Discussion by Dr. J. J. Moorhead, Interborough Traction Company, New York City.

General Session: Health

Friday Afternoon, October 3, 2:00 o'clock

Ball Room, Mezzanine Floor

Chairman, Dr. Chas. A. Lauffer,

Medical Director, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

PROGRAM

I. The Scope of Physical Examination in Industry.

Dr. C. D. Selby, Toledo, Ohio, formerly Consulting Hygienist, United States Public Health Service.

II. The Industrial Clinic.

Dr. D. L. Edsall, Dean, Harvard Medical School Boston, Mass.

III. Health Education in Industry.

Dr. W. A. Evans, Chicago.

IV. Co-ordination of Industrial and Community Health Activities.

Dr. C. E. Ford, General Chemical Company, New York City.

Discussion.

AMERICAN PUBLIC HEALTH ASSOCIATION

Industrial Hygiene Section

Following is the preliminary program of the Industrial Hygiene Section of the American Public Health Association, which is to be presented at the New Orleans meeting, October 27-30. The final program will be published in the American Journal of Public Health appearing October 7, or may be had upon application after that date to the secretary at 169 Massachusetts Avenue, Boston, Massachusetts.

Monday, October 27, 2:00 p.m.

Address of Chairman. Need and Method of Coördinating Federal, State and Local Health Agencies in Promoting Industrial Hygiene.

A Program for Organizing and Coördinating Industrial Clinics. T. Grier Miller, M.D., *University of Pennsylvania, Philadelphia, Pa.*

Utilizing the Out-Patient Department for Industrial Clinic Work. Wade Wright, *Massachusetts General Hospital, Boston, Mass.*

Utilizing Records of Plant Medical and Surgical Departments for Furthering Plant Hygiene. Bernard J. Newman.

Placement and Replacement of Employees on the Basis of Physical Examinations. Harry Mock, M.D., *Chicago.*

Classifying Employees and Increasing Production by Improving Their Physical Condition. Wm. J. Curry, M.D., *Holyoke, Mass.*

Tuesday, October 28, 9:00 a.m.

Fundamental Factors in Plant Hygiene. Don Lowe, M.D., *Akron, Ohio.*

Health Hazards of Non-Poisonous Dusts. Emery R. Hayhurst, M.D., *University of Ohio, Columbus, Ohio.*

Health Hazards of the Dye Industry. C. E. Ford, M.D., *New York, N. Y.*

Systematic and Dermatic Effects from the Use of Cutting Oils and Compounds. H. D. Pease, M.D., *Lederle Laboratories, New York, N. Y.*

Industrial Fatigue: Present Status of Investigations. Frederic S. Lee, M.D., *New York, N. Y.*

Wednesday, October 29, 9:00 a.m.

Special Health Hazards of Women Industrial Workers. Lillian Erskine.

The Insurance Company and Industrial Hygiene. Austin D. Reiley, *New York.*

The Industrial Physician and Welfare Work. W. Irving Clark, M.D., *Worcester, Mass.*

The Part Played by Community Insanitation in the Incidence of Industrial Diseases. Roger Perkins, *Cleveland, O.*

Legislative Standards in the Field of Industrial Hygiene.

Sociological Section

Following is the preliminary program of the Sociological Section of the American Public Health Association, which is to be presented at the New Orleans meeting, October 27-30. The final program will be published in the American Journal of Public Health appearing October 7, or may be had upon application after that date to the secretary at 169 Massachusetts Avenue, Boston, Massachusetts.

Chairman, Louis I. Harris, M.D., *New York City.*
Vice-Chairman, Ira S. Wile, M.D., *New York City.*
Secretary, Walter H. Brown, M.D., *Bridgeport, Conn.*

Correspondence concerning this Section should be addressed to the program chairman, Dr. Brown, at 280 Glenwood Ave., Bridgeport, Conn.

First Session

The Relations of Living Conditions to Health

The Family Budget and Health. Royal S. Meeker, *Commissioner of Labor Statistics, Washington, D. C.*

The Sociological Aspect of Housing. Ira S. Wile, M.D., *New York City.*

The Sanitarian's Definition of a Living Wage. (Speaker to be announced.)

Second Session

The Influence of Industrial Relations upon Health

(Proposed joint session with Industrial Hygiene Section not yet accepted)

The Point of View of the Employer. Mr. Magnus W. Alexander, *National Industrial Conference Board Boston, Mass.*

The Point of View of the Employee. Mr. Frank Morrison, *American Federation of Labor, Washington, D. C.*

The Point of View of the Public Health Worker. Louis I. Harris, M.D., *Director of the Bureau of Preventable Diseases, State Department of Health, New York City.*

Third Session

Symposium on Community Medicine

The Community Use of Group Medicine. Richard H. Cabot, M.D., *Boston, Mass.*

Health Centers. (Speaker to be announced.)

Evaluation of the Community Unit Experiment. Haven Emerson, M.D., *New York, N. Y.*

Fourth Session

Miscellaneous

A Study of the Social Condition of Dispensary Patients. E. H. Lewinski-Corwin, Ph.D., *New York City.*

The Sociological Aspect of the Hookworm. Oscar H. Dowling, M.D., *State Commissioner of Health, New Orleans, La.*

The Sociological Aspect of Pellagra. Ed J. Wood, M.D. *Wilmington, N. C.*

LECTURES BY DR. THOMAS M. LEGGE

Harvard University announces that Dr. Thomas M. Legge, Chief Medical Inspector of Factories in Great Britain, has been invited to give a course of Lowell Lectures and the Cutter Lectures in Preventive Medicine for the coming year. These lectures will be given under the auspices of the School of Public Health of Harvard University and the Massachusetts Institute of Technology, and the Division of Industrial Hygiene. Dr. Legge will lecture in Boston on November 18 and ensuing dates upon the following subjects:

Twenty Years' Experience of the Notification of Industrial Disease.

Twelve Years' Experience of Workman's Compensation Act and Industrial Diseases.

Medical Supervision in Factories.

Industrial Poisons and Their Prevention.

Anthrax.

Fumes and Gases.

Industrial Fatigue.

Industry as a Subject for Art.

Manufacture Under the Mediaeval Trade Guilds.

The completed schedule of lectures will be issued on October 20.

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THE ELECTROSTATIC METHOD OF DUST COLLECTION AS APPLIED TO THE SANITARY ANALYSIS OF AIR *

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IN the industries, the air washer and bag house for the removal of dust have in many instances been replaced by the more effective method of electrical precipitation. The present studies were undertaken with the idea of inquiring into the usefulness of electrical precipitation in the sanitary analysis of air, as compared with other methods already in use.

HISTORICAL

Many methods have been advanced for the removal of particulate matter from air and gases with a view toward studying it at closer range. The very number is indicative of the fact that most methods have serious drawbacks save under special conditions.

Dust collection for laboratory study primarily depends upon a measured quantity of air in motion. Methods used heretofore may be roughly grouped according to the principles involved in recovering dust from air.

I. *Impaction Methods.* — The dust particles in motion are forcibly directed against retaining surfaces specially prepared with sticky substances. This group includes the use of porcelain plates, paper, glass tubes, microscope slides, etc., which have been coated with glycerin (1, 3, 4, 7,), oil (5, 10), gum acacia (3), silicate of soda (3), and resin (10).

The well-known effect of dust on a photographic plate has been suggested as a convenient method to register the number of particles (4). Gravity alone (9), and centrifugalization (38) have also been used to study dust in the air.

II. *Filtration Methods.* — The principle of filtration has been resorted to in a variety of devices, the most important feature being the character of the filtering medium. For this purpose, sugar has been much used (11, 12, 13, 16, 18, 28) and to a lesser degree dependence has been placed upon extraction thimbles alone (6) or with cotton (10), cotton wool alone (1, 4, 17), resorcinol (14), fine mesh wire cloth (2), water (4, 7, 21, 38), filter paper (5, 10), collodion wool (5, 10), cheese cloth (10) and canton flannel (19).

III. *Condensation Methods* depend primarily upon condensation of water vapor around dust particles in a rarefied atmosphere. In the koniscope the resulting fog is compared with suitable standards to determine the extent of air dustiness, while with the Aitken dust counter the condensed moisture is precipitated by gravity and the minute droplets counted directly (22).

IV. *The Electrostatic Precipitation* of dust particles is based on a principle long known (23, 25, 26). The method has been recently applied commercially to the recovery of valuable dusts, but its use for the sanitary analysis of air is here reported for the first time. A discussion of the principle involved would be foreign to the purpose of this paper, but can be found in the appended bibliography (33, 34). Briefly, it depends upon the ionization of finely divided substances in an electric field, and upon the laws of electrically charged bodies.

A sample having been collected, it is essential that the characteristics of the parti-

* Thesis presented for the Doctor of Public Health degree. Received for publication August 14, 1919.

cles be determined. For this purpose, three methods supply facts of interest.

A. Macroscopic comparison of the turbidity of the sample with standard suspensions gives an approximate idea of the amount present.

B. Weighing methods are, however, much more accurate. The sample may be weighed after filtration or evaporation, or directly in the collector.

C. Microscopic methods. Counting the particles, either in the suspending medium, or directly on the collector, tells at once something of their size and number, as well as their character.

The disadvantages of the methods of collecting dust outlined above are many. In those depending on impaction it is difficult, if not impossible, to determine accurately the relative percentage of dust particles of various sizes retained by the collecting medium. Filtration methods have helped to overcome this and other objections, but in themselves offer new difficulties connected with weighing the dust or separating it from the filtering medium. Aitken's dust counter and similar devices have been little used because they do not permit differentiation between particles of large size which are of sanitary importance and those of smaller size and of little sanitary importance (15). The latter, however, act as nuclei for condensation and thereby are largely responsible for the large counts obtained with this instrument (13).

The ideal method of sampling dust should use a simple apparatus that is at once reliable, portable, and cheap. A pump of some sort is a necessity if large-sized samples are to be collected in a comparatively short time. Again, the ideal method would preferably use no liquid suspending medium, yet should be applicable to all kinds of dusts, soluble and insoluble, fragile and otherwise, and to fumes as well. Dust is finely divided particulate matter of varying size. It comes from all sorts of organic and inorganic material, and is of widely different specific gravities. Obviously poisonous dusts, soluble in a liquid collecting medium, will not only be lost if filtration is used in the subsequent analysis, but their importance may be missed in the interpretation of results. The ideal method should retain unchanged all the dust present in the air sample or at least the percentage actually collected should be known. Finally, it would permit obtaining of data covering weight, size, number and other physical as well as chemical characters of particles.

The activity of dust particles in an electrically charged atmosphere is a well-known phenomenon. The earliest references to this fact appeared in the literature in 1824 (23) and 1850 (24). The first practical application was patented in 1884 (36) and was intended to recover valuable dusts. Since that time, considerable work has been done by Lodge (25), Cottrell (26, 27, 28, 29), and others (31, 32), directed toward the industrial application of this principle either for the recovery of by-products or the prevention of nuisance (30).

Development of Experimental Apparatus

Since the original methods employing static electricity generated by Wimshurst and other influence machines were devised, much more reliable and more easily controlled uni-directional currents of high potential have been made possible through advances in the study of alternating current.

An apparatus for the study by electrical precipitaton of air dust must include:

1. A collecting and an ionizing electrode.
2. A high-tension transformer.
3. A rectifying device for the high potential alternating secondary current.
4. A source of alternating current to excite the transformer.
5. A pump or fan for passing the air to be studied through the electrically charged field.

It requires roughly about 30,000 volts pressure to cause a disruptive discharge across a 1-inch air gap, dependent upon the type of electrodes used and upon other factors. A secondary current of this voltage used in the collector would permit the employment of metallic tubing 2 inches or a little more in diameter, which is a convenient size to handle. Moreover, the problems attendant upon efficient insulation are easier of solution for this than for higher voltages.

With these facts in mind, the original collector consisted of a drawn brass tube of $2\frac{1}{2}$ inches outside diameter, and 18 inches long, with a wall $\frac{1}{16}$ of an inch thick. This was cut longitudinally into two parts with a slitting saw, the halves hinged and provided with catches and offset collars in such a way that the collector could be easily removed from the supporting ring, yet be

as tight as possible, and always stay in the same position relative to its axis. The supports were mounted on a verticle standard, the lower one being a ring, and the upper one being built into a small wooden header chamber with glass sides and top (Fig. 1, 1). From the back of the header chamber tin tubing, 2⅛ inches (Fig. 1, 2) outside diameter, carried the air downward to a suction fan.

A 100 watt, 4 pole motor generator, running at 1800 revolutions per minute (Fig. 1, 3), was secured to excite the transformer. This runs on 110 volts direct current and gives 75 volts on the alternating side. A closed core air-cooled transformer was built to be actuated by the motor generator. This has a winding ratio of 1 to 300. While the primary was provided with variable leads so as to vary the ratio of transformation, preliminary trials showed that the 1 to 300 ratio gave the most satisfactory discharge in the collectors used (roughly 20,000 volts), and was employed, therefore, throughout the experiments. Later on, the transformer suffered a partial break-down and for that reason was immersed in oil (Fig. 1, 4).

At the time the apparatus was being developed (1915), rectifying valves were not available (30), and the choice of a rectifier lay between the disc and stick types. For several reasons based largely on the author's experience with electrotherapeutic apparatus, the stick type was chosen as offering the least difficulty in maintenance and operation (Fig. 1, 5).

It was found essential to include variable resistance in the low-tension side of the alternating current to prevent disruptive discharges, which were harmful to the entire system and which defeated the electrical purpose of the apparatus (Fig. 1, 6). Of the rectified, pulsating, uni-directional current led to the collector, the positive was led to the metal support of the collector shell and the whole grounded (Fig. 1, 7), while the negative, shown to be the most efficient for this purpose (33, 35), was led to the central electrode in the axis of the collector (Fig. 1, 8). All wires used for connections, particularly on the high-tension side, were insulated, since even a continuous bare wire will evidence brush discharges from angles or irregularities of surface.

The collector and ionizing electrode were the subjects of many preliminary tests. The glass top of the header chamber was drilled through, and acted as an insulated support for the ionizing electrode. The exhaust fan delivers by anemometer test 1624.2 linear feet per minute, or 1513.2 cubic feet of air per hour — 25.22 cubic feet per minute. The first trials with a solid duct from inlet to outlet, therefore, implied that dust particles would have a linear velocity of something less than 27 feet per second, and would be exposed in a corona discharge 18 inches long for about 1/18 second. While ionization is practically instantaneous, this seemed at first glance to be too great a velocity. That this was so was shown by deposition of dust in the fan case and by the exit of portions of experimental charges. In order to correct this difficulty, a Bunsen valve with two openings about 2½ by ⅝ inches, provided with a sliding collar for closure, was installed (Fig. 1, 9) at a point 10 inches from the header chamber. With the resulting reduced linear velocity, most of the precipitating occurred in roughly the lower third of the collector. Various types of ionizing electrodes were tried. Ionizers were made of plain, heavy and light wire of different materials, heavy wire roughed by various means, and twisted wire composed of two strands. The twisted wire electrodes were found to produce the most constant and intense corona effect with the least brush discharge.

While the upper support of the ionizing electrode was a simple matter because of the glass wall there available, the lower support, because of the strain incident to tightening the wire, presented some difficulties. In a preliminary tube collector a piece of glass rod was fitted into a bayonet lock, cut in the bottom of the collector. When the divided tube was devised, a different kind of support was essential. A triangular-shaped piece of window glass provided with a wire support caused ionization of experimental charges of particulate material before the air current had a chance to pull them through. The ionized clots were thrown back on the watch glass used for applying them; moreover, considerable of the material tended to stick to the vane and the latter too introduced a factor of error into the entry of air, through eddy currents which were not desirable. An inverted V-shaped glass vane was so constructed as to rest on the edge of the lower ring supporting the collector. The ionizer

electrode, by being shortened inside the collector, influenced dust particles so that they were precipitated on the collector walls and not on the lower supporting ring. Again, the divided collector could be removed without disturbing the ionizer.

To detect particles thrown out of the collector, an old photographic negative, glass side up, was found useful as a background on which dust particles could be seen, recovered, and re-applied to the collector in a manner presently to be explained.

Measurement of Air Passing Through Collector

While a Pitot tube would have been desirable for this purpose, none small enough was available and reliance had to be placed on a standardized anemometer.

With the hinged collector in place, the anemometer was placed in as many different positions as possible in the rather limited space in the header, and with a stop watch and string control on the anemometer starting lever, ten series of runs were made with the Bunsen valve open. The fan motor was run continuously throughout these tests, and variations in line voltage were noticeable both in a voltmeter across the mains and in the variable results obtained. The variations were no doubt also due to the different positions across the cross section of the collector in which the anemometer was placed. Since the internal diameter of the hinged collector was $2\frac{3}{8}$ inches, there entered at the linear velocity of 309.85 feet per minute, 9.53 cubic feet of air through the bottom of the header, the collector being in place.

Preliminary Efficiency Tests

That some check on the efficiency of the machine might be made, a series of determinations was made on weighed portions of room dust recovered from the tops of bookcases, of which measured amounts were aspirated into the machine, regathered and reweighed. Various methods of applying the dust charges were employed. These included using the end of a knife, brushing off a piece of glazed paper, using compressed air in a device like a boiler injector, provided with a small funnel for the dust charge, rapping metal and glass plates with an electric bell, etc. The most satisfactory was found to be the following. A pair of accurately matched watch glasses was placed on the chemical balance. On one the dust or other particulate matter was weighed out to one-tenth of a milligram. The other was used as a cover in carrying the charge to the collector. The loaded crystal was then sharply rapped by hand against the bottom of the collector. This tended to reduce the amount of air passing through the instrument, which factor did not interfere with the purpose of this series of determinations but even assisted in blowing off the dust charge as the particles were dislodged by rapping. Residue on the crystal was brushed off by a camel's hair brush in such a way that the particles were swept off into the mouth of the collector by the bristles being held in a position nearly parallel to the surface of the crystal. Any dust thrown out of the collector by ionization in spite of the air current was added to and swept off the crystal from the photographic negative.

The dust was recovered by carefully brushing out the collector on the watch crystal used in applying the charge, employing the same brush used for cleaning off the watch glass. By this technic, in a series of tests using 50 mg., 100 mg., and 200 mg. charges, roughly about 80 per cent. was recovered.

In part, losses occurred: (1) through brushing, causing some of the finer particles to fly into the air, both in applying and recollecting; (2) through part of the charge sticking to the collector supporting ring; (3) to a portion of the charge being retained on the ionizing electrode and its lower support; (4) to particles being retained on the brush; and (5) to heavy gritty particles, siliceous in character, which rapidly fell off the collector walls after the current was turned off.

Attempts to correct these errors were made as follows: (1) All air currents in the room were eliminated so far as possible by closing doors and windows, by breathing behind a mask, and by using utmost care in brushing. (2) The collector supporting ring was brushed off so far as practicable in recollecting, as was (3) that portion retained on the ionizing electrode and its glass vane support. This latter was replaced by a V-shaped support of 2-mm. glass rod, following tests using finely divided paper particles. (4) The small amount retained by the brush (which was a 1-inch, flat camel's hair) was recovered by sharply rapping the latter vertically on the photographic negative. (5) The crude dust

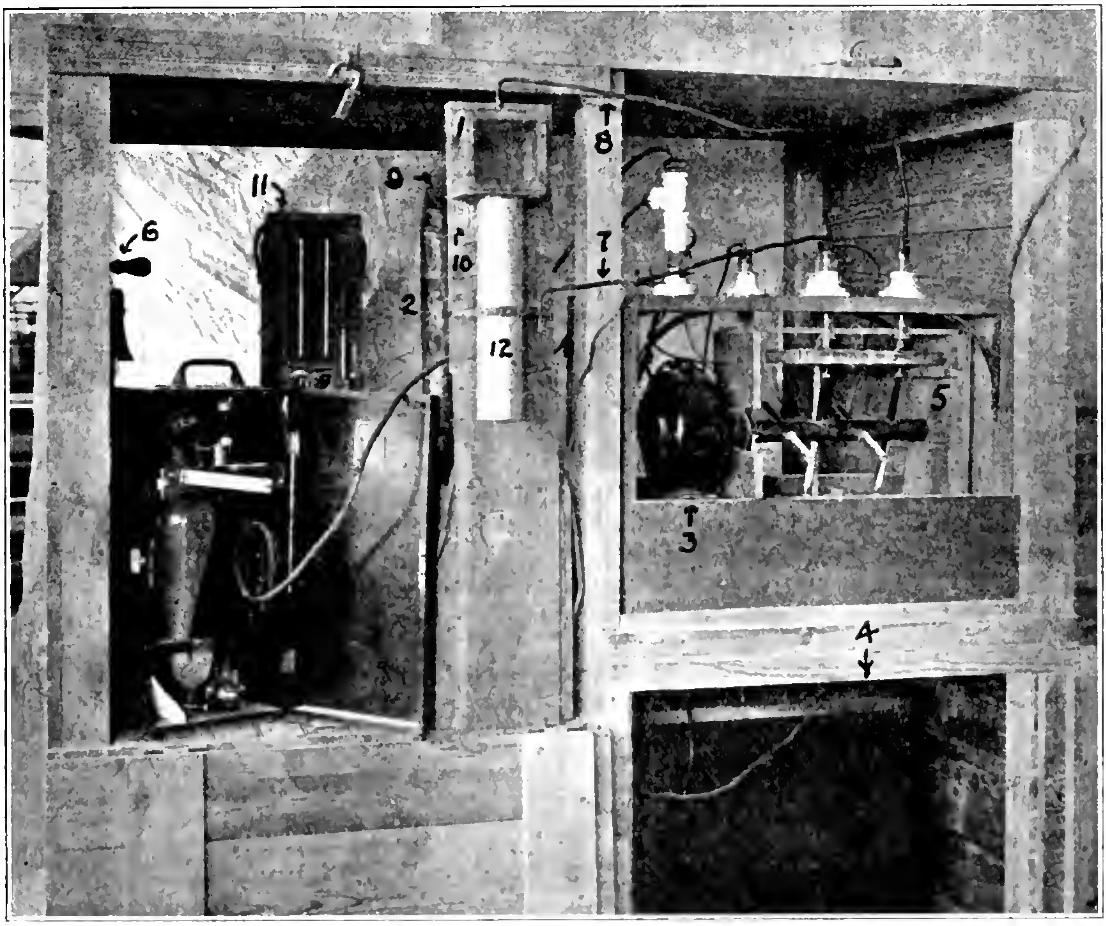

FIG. 1. — 1. Header chamber. 2. Conveyor duct. 3. Motor generator. 4. Transformer. 5. Rectifier. 6. Low-tension variable resistance. 7. Positive high-tension lead, grounded. 8. Negative high-tension lead, to ionizing electrode. 9. Bunsen valve in conveyor duct. 10. Sliding valve, to restrict cross section of conveyor duct. 11. Portable psychrometer. 12. Collecting electrode.

was sifted through 100-mesh wire cloth and only the portion passing through used. An electric bell tapper applied to the wire cloth expedited this process. In addition, a number 7 rubber stopper with a stirring rod handle was used for a policeman. With these changes in technic slightly higher returns were obtained. (Table I.)

It was suggested that weighing the collector with its dust deposit might offer facts of interest. The brass collector, however, weighed 1300 grams, and since the dust charges were small and no scales available, weighing over a kilogram with a sensibility of at least 1 mg., this procedure had, for the time being, to be abandoned.

It was noticed in making maintenance tests, when the apparatus was first constructed, that evidence of copper salts appeared in the upper stretches of the collector. Beads of moisture, moreover, in the same region gave a strong acid reaction to litmus. This was assumed to be due to nitric acid. Furthermore, it was noticed that the effect of ozone in a confined room after several hours run was markedly irritating. There arose, therefore, the possibility of chemical changes occurring in the dust. In addition, the question of moisture being responsible for a possible source of error presented itself.

Pyrogallic acid was chosen to study these points because of its availability, color, small size of particles, and chemical instability. Psychrometric readings were made on the air of the laboratory to determine the amount of water vapor passing through the collector. Later, tests were made to determine the hygroscopicity of sifted dust similar to that used above. Weighed quantities were put in a dessicator for periods covering several days. In 50-mg. charges, there was no appreciable loss of weight, but with larger quantities (over 1 gm.) losses of nearly 1 per cent. were encountered.

The gallol charges showed definitely the

distribution of particles under ionization. At the bottom of the collector a dead area appeared, somewhat shorter than the effective length of the ionizer support, which was $2\frac{3}{4}$ inches long. Above, a clear white zone about $1\frac{1}{2}$ inches wide was followed by a wider one about $4\frac{1}{2}$ inches long, wherein the gallol had a slight brown discoloration and above which only a very few scattered particles were to be seen. Whatever the nature of this change might be, it apparently depended in part, at least, on relative humidity. For example, the discoloration was more marked with an absolute humidity of 6 grains than with 2.4 grains per cubic foot of laboratory air, varying from a faint straw color to a decided brown in the former instance. With gallol this color can be detected after short exposures (about two minutes) and becomes somewhat intensified after prolonged exposure (ninety minutes). Disruptive discharges, when they occurred, manifested themselves afterward in the form of punctate areas in the deposit where the crystals were destroyed.

Because evidence of corrosion such as previously mentioned still appeared in a region apparently above the effective zone of precipitation, the ionizer support was lengthened to $5\frac{1}{2}$ inches. After this change, the corona discharge not only was more intense, but corrosion disappeared. A series of gallol charges was applied to the collector, and on recovery averaged 92.7 per cent. returned.

Humidity is an essential for electrostatic precipitation (32). Whether or not humidity in connection with nitrous oxid or by itself has any effect on the precipitated material, is, with the possible exception of the suggestive observation made in connection with gallol, unknown. Talc was next used, as a more or less inert material, to determine whether losses in recovered weight were due to the character of the material or to the technic of recovery. It was at once evident that considerable of this material remained on all of the surfaces affected as well as on the camel's hair brush. A sliding valve in the back of the header chamber (Fig. 1, 10) being opened and closed only while the ionizing current was turned on, the losses could not be explained even in part by passage of particles through to the fan. The material on the blades and hub was compared under the microscope, however, with talc particles by direct and indirect lighting, and all examined gave an entirely different appearance. Moreover, a 500-mg. charge of calcium carbonate, passed through a 100-mesh sieve, and applied rapidly with the idea of forcing some to pass un-ionized, if possible, yielded 472 mg. on recovery. The fan was carefully cleaned and the detritus acidulated with hydrochloric acid and given the flame test for calcium, with negative results. Previous experience had shown that most of the material passing through the conveyor system tended to lodge on the fan.

Attempts to weigh the small portion of experimental charges gathered by the brush seemed to be difficult because of the hygroscopicity of hair. A special brush made of long bristles with split and flesh ends removed, bent in the middle and wired into an aluminum holder, offered the same difficulty. A camel's hair brush, for instance, dried over sulphuric acid for 48 hours weighed 12.147 gm. Left overnight on the scale pan with the door partly open, its weight had increased by 93 mg. It seemed reasonable, however, to assume that if the brush under room conditions was weighed before and after use that the difference would represent fairly accurately the material gathered by it. Further tests using talc and magnesium oxid were made and brush losses determined, with unsatisfactory results. (Table I.)

Loss in Weight

As far as these tests demonstrated them, the losses of weight in artificially applied dust charges may be summed up as:

1. That attendant upon applying the charge.
2. That pulled through the ionizing zone.
3. That due to possible electro-chemical changes.
4. That due to electrical attraction of covering watch crystal for charge while being carried from scales to collector.
5. The portion lost in recovery because of:
   (a) Not brushing or scraping all out of collector.
   (b) Residue on ionizer (37).
   (c) Brush and policeman loss.
   (d) Loss in applying recovered charge to scale pan for reweighing.

1. Upon the choice of brushing off total charge or of jarring off all that can be so dislodged and following this by sweeping, comment has already been made, based on the writer's experience, in favor of the latter.

2. With air currents of low velocity such

as finally used, together with care in allowing air to pass through only when the corona discharge is operating, there is no tangible evidence that loss of weight occurs from dust charges pulled through the ionizing zone. During disruptive discharges, however, which are of the flaming arc type, the corona disappears. There is, therefore, a chance for (a) the air current to sweep off some of the material, and (b) for the destruction of a small portion. It is essential for the most favorable effect that just enough resistance be placed in the alternating primary to bring down the discharge below this point. Due to variations in secondary potential of various causes, disruptive effects or static discharges may, however, occasionally occur.

3. As applied to ordinary dusts, electrochemical changes are unknown. Design of the collector to include only the most effective precipitating zone will tend, however, to eliminate them, at least so far as dust on the collector walls is concerned.

4. Loss due to electrical attraction of covering watch crystal for charge was noted in but few instances. If the crystals are placed together before weighing sufficiently long for both to assume the same polarity, it will not happen.

5. The loss encountered in recovering experimental charges is apparently the largest. It certainly is the most obvious. As will be shown later, 5a, 5c, and 5d are obviated by weighing the collector with its dust charge *in situ*. Dust remaining on the ionizer may for ordinary purposes be ignored since it is impracticable to try to recover it.

A further possible source of change in weight, but one which was not inquired into, is the effect of different atmospheric conditions. In the practical use of the machine, humidity was determined by means

TABLE I — PRELIMINARY TESTS

Material	Time of Application m.: s.	Charge mg.	Return mg.	Brush Weight Increase	Total mg.	Per Cent. Returned	Per Cent. Lost	Group Average %	Barometer inches	Dry Bulb F.	Wet Bulb F.	Relative Humidity %	Absolute Humidity gr. cu. ft.
Dust	....	100	70	....	....	70	30						
Dust	....	100	75	....	....	75	25						
Dust	....	200	165	....	....	82.5	17.5						
Dust	....	200	155	....	....	77.5	23.5						
Dust	....	200	177	....	....	88.5	12.5						
Dust	....	200	178	....	....	89	11	80.4					
Paper	....	200	200	....	....	100							
Paper	....	200	200	....	....	100		100					
Gallol	....	200	197	....	....	98.5	1.5						
Gallol	....	200	186	....	....	93	7		30.42	63.5	52.5	47	3.08
Gallol	....	200	190	....	....	95	5		30.42	65	55.5	54	3.66
Gallol	3:10	50	45	....	....	90	10		30.25	70	54	33	2.63
Gallol	3	50	45	....	....	90	10		30.25	70	54	33	2.63
Gallol	1:7	50	45	....	....	90	10		30.25	70	54	33	2.63
Gallol	2:20	50	45			90	10		30.25	70	54	33	2.63
Gallol	2:18	100	91			91	9		30.12	68	52	31	2.31
Gallol	2:34	100	97			97	3		30.12	68	52	31	2.31
Gallol	1:59	100	93			93	7		30.12	68	52	31	2.31
Gallol	2:22	100	94			94	6		30.12	68	52	31	2.31
Gallol	2:33	100	94			94	6		29.7	73	64.5	63	5.52
Gallol	2:10	100	91			91	9	92.7	29.4	73	64.5	63	5.52
Talc	1:50	50	35			70	30		30.2	67.5	54.5	41	2.96
Talc	1:47	50	32			64	36		30.2	67.5	54.5	41	2.96
Talc	1	50	35			70	30		30.3	67.5	54.5	41	2.96
Talc	2:10	50	39			78	22		30	70.5	54	31	2.47
Talc	1:30	50	42			84	16		30	70.5	54	31	2.47
Talc	2:20	50	40			80	20		30.12	69	53	32	2.47
Talc	2:3	50	39			78	22	74.8	30.12	69	53	32	2.47
Talc	2:30	100	85	13	98	98	2		30.12	71.5	53.5	27	2.24
Talc	2:27	100	90	12	102	102	+2		30.12	71.5	53.5	27	2.34
Talc	2:12	100	89	15	104	104	+4		29.88	68.5	55.5	40	2.99
Talc	2:20	100	89	19	108	108	+8	88	29.88	68.5	55.5	40	2.99
MgO	2:17	50	44	10	54	108	+8		30.37	67.5	52	32	1.95
MgO	3:10	100	93	8	101	101	+1		30.24	64.5	49	33	2.23
MgO	2:17	100	95	7	102	102	+2		30.24	64.5	49	33	2.23
MgO	2:38	100	95	4	99	88	1		30.24	64.5	49	33	2.23
MgO	1:55	100	93	2	95	95	5	92.8	30.24	64.5	49	33	2.23
CaCO	....	500	472	4	476	95.2	4.8	95.2					

Total average return, all tests, 89.2%   Total average return, excluding paper tests, 87.7%

of a portable psychrometer (Fig. 1, 11), and other data were obtained to facilitate further work on the subject. The time during which the charges were applied is also given, wherever taken.

This series of preliminary tests was made with the idea of studying the effect of ionization and of trying to improve the percentage recovered. Various minor changes in design and operation of the collector and of technic were adopted as they seemed best.

Second Series

Since the use of brushes in re-collecting seemed to introduce errors which could not be corrected, another series of tests using the same substances in charges of various sizes was made, discarding the brush and using the policeman alone. The collector was cleaned with brass polish to eliminate so far as possible any roughness due to oxidation. These tests are summarized in Table II. The average for these tests showed that 90.01 per cent. was returned.

With the idea of still further lessening chances for error by weighing the collector with its charge *in situ*, a piece of aluminum tubing of $2\frac{1}{2}$ inches outside diameter and with 18-gauge walls was procured. Since the effective zone of ionization would for the most part be covered by a length of 12 inches, this was adopted (Fig. 1, 12), necessitating structural changes in the collector supports. Instead of a bottom supporting ring, itself a cause of trouble, tension on the ionizing electrode was used to hold the tube in place, assisted by a grooved wooden block against the vertical support. The glass stirrup for holding the lower end of the ionizer was replaced by a piece of soft twisted seine twine, armed on the ends

TABLE II.—SECOND SERIES

Material	Time of Application min.: sec.	Charge mg.	Return mg.	Return %	Loss %	Average %	Barometer inches	Dry Bulb F.	Wet Bulb F.	Relative Humidity %	Absolute Humidity gr. cu. ft.
Talc	1:32	50	37	74	26	....	30.32	65.5	51	33	2.23
Talc	2:20	50	40	80	20	....	29.74	64	53	47	3.01
Talc	1:27	50	32	64	36	....	29.94	63.5	50	36	2.38
Talc	1:32	50	38	76	24	....	29.94	63.5	50	36	2.38
Talc	1:41	50	39	78	22	....	29.94	63.5	50	36	2.38
Talc	2:27	50	42	84	16	....	29.94	64	50	34	2.12
Talc	2:11	50	43	86	14	....	29.94	64	51	38	2.38
Talc	1:55	50	44	88	12	....	29.94	64	51	38	2.38
Talc	1:32	50	43	86	14	79.5	29.94	64	51	38	2.38
Talc	1:28	100	91	91	9	....	29.94	64	51	38	2.38
Talc	1:30	100	91	91	9	....	29.94	64	51	38	2.38
Talc	1:32	100	90	90	10	....	29.94	64	51	38	2.38
Talc	:56	100	90	90	10	....	29.94	64	51	38	2.38
Talc	1:37	100	91	91	9	90.6	29.94	64	51	38	2.38
MgO	1: 2	50	48	96	4	....	30.01	64	49.5	36	2.38
MgO	1: 3	50	49	98	2	....	30.01	64	49.5	36	2.38
MgO	1:15	50	48	96	4	....	30.01	64	49.5	36	2.38
MgO	1: 2	50	48	96	4	....	30.01	64	49.5	36	2.38
MgO	1: 2	50	47	94	6	96	30.01	64	49.5	36	2.38
MgO	1:11	100	96	96	4	....	30.15	66	51	32	2.24
MgO	1:14	100	96	96	4	....	30.15	66	51	32	2.24
MgO	1:25	100	97	97	3	....	30.15	66	51	32	2.24
MgO	1:55	100	99	99	1	....	30.15	66	51	32	2.24
MgO	1:25	100	98	98	2	97.2	30.15	66	51	32	2.24
Dust	1: 6	50	44	88	12	....	30.15	66	51	32	2.24
Dust	1:22	50	43	86	14	....	30.15	66	51	32	2.24
Dust	1:15	50	45	90	10	....	30.1	68	52	31	2.38
Dust	1:11	50	42	84	16	....	30.1	68	52	31	2.38
Dust	1:50	50	43	86	14	....	30.1	68	52	31	2.38
Dust	2: 2	50	44	88	12	....	30.1	68	52	31	2.38
Dust	1:23	50	44	88	12	....	30.1	68	52	31	2.38
Dust	1:17	50	45	90	10	....	30.1	68	52	31	2.38
Dust	1:40	50	44	88	12	....	30.1	68	52	31	2.38
Dust	1:35	50	43	86	14	87.4	30.1	68	52	31	2.38
Dust	1:23	100	91	91	9	....	30.1	68	52	31	2.38
Dust	1:28	100	89	89	11	....	30.1	68	52	31	2.38
Dust	1:18	100	90	90	10	....	30.1	68	52	31	2.38
Dust	1:22	100	89	89	11	....	30.1	68	52	31	2.38
Dust	1:17	100	88	88	12	89.4	30.1	68	52	31	2.38

Total average return, 90.0%

with two small wire hooks to engage the lower edge of the collector. An S-hook in glass rod, about ½ inch long, connecting the lower end of the ionizer with its twine support, was found to prevent rotting of the twine and leakage of current.

No scales being available capable of handling an object so large, the collector was weighed by hanging it on a piece of hard-drawn brass wire, which passed through the bottom of the scale case, and through a hole in the scale shelf, entirely replacing the scale pan. While pendant, it was protected from drafts by a box with glass sides. The original aluminum shell was suspended by a yoke fitting in two small holes drilled through the collector walls along the upper edge. In the later shells, a sliding noose of brass wire was employed. While in the former method air friction was reduced to a minimum, occasionally particles became dislodged and fell into the watch crystal placed below. By the latter arrangement the collector was hung diagonally, but with the collected dust zone uppermost: particles on being dislodged landed on the lower wall of the collector and were thus retained. The weight of the aluminum collectors used was approximately 118 gm.

With the new collector sixty-three anemometer tests were made, covering periods ranging from ten minutes to nearly two hours, giving an average linear velocity of 311.4 feet per minute with the Bunsen and sliding valves open. The shell walls were 0.03631 inch thick. The total air per minute passing through at the average rate would be:

$$\frac{(2.5-0.07262)^2 \times 0.7854 \times 311.4}{144} = 10.005 \text{ cubic}$$

feet or 600.03 cubic feet per hour.

TABLE III. — THIRD SERIES: 50 MG. CHARGES: DUST

Time of Application min.: sec.	Dry Bulb F.	Wet Bulb F.	Barometer m.m.	Relative Humidity %	Absolute Humidity gr. cu. ft.	Return mg.	Return %	Loss %
2: 9	72.5	53	771.8	24	2.04	48	96	4
2:32	72.5	53	771.8	24	2.04	46.7	93.4	6.6
1:58	72.5	53	771.8	24	2.04	47	94	6
1:45	72.5	53	771.8	24	2.04	47.2	94.4	5.6
2:32	68.5	52	770.9	30	2.31	46.4	92.8	7.2
1:24	68.5	52	770.9	30	2.31	46.6	93.2	6.8
1:28	68.5	52	770.9	30	2.31	47.5	95	5
1:12	68.5	52	770.9	30	2.31	48.2	96.4	3.6
1:36	68.5	55	767.4	41	3.16	47.5	95	5
1: 2	68.5	55	767.4	41	3.16	47.5	95	5
52	73	54	761	25	2.19	49	98	2
1:42	72.5	52	764.6	19	1.66	47	94	6
50	72.5	52	764.6	19	1.66	47	94	6
1:17	72.5	52	764.6	19	1.66	48.3	96.3	3.4
58	70.5	56	757.5	43	3.42	49.2	98.4	1.6
1:22	70.5	56	757.5	43	3.42	48.5	97	3
1: 5	70.5	56	757.5	43	3.42	49	98	2
1: 4	70.5	56	757.5	43	3.42	47.5	95	5
1:13	70.5	56	757.5	43	3.42	49.2	98.4	1.6
42	75.5	54	768.7	21	2.02	49	98	2
1:24	75.5	54	768.7	21	2.02	48.2	96.4	3.6
57	75.5	54	768.7	21	2.02	49.2	98.4	1.6
1:20	75.5	54	768.7	21	2.02	48.8	97.6	2.4
1:11	70	55	768.3	36	2.68	49	98	2
1:12	70	55	768.3	36	2.68	48.7	97.4	2.6
1:21	70	55	768.3	36	2.68	48.2	96.4	3.6
1: 3	72.5	56.5	766.6	39	3.43	48.7	97.4	2.6
58	72.5	56.5	766.6	39	3.43	48	96	4
42	72.5	56.5	766.6	39	3.43	48.4	96.8	3.2
1: 1	72.5	56.5	766.6	39	3.43	48.2	96.4	3.6

Average return, 48.05 mg., 96.1%

A series of ten tests using 100-mg. dust charges, in which the increase in weight of the collector was noted, together with that of one of the watch crystals placed underneath to catch dislodged particles, averaged 98.2 per cent., indicating that this technic offered more satisfactory results than the former in which the dust was removed for reweighing.

At this point, a Wallace Tiernan sugar filter (13) and a Palmer water spray apparatus (38) were obtained in order to com-

pare results with the high-tension apparatus. Because of the difficulty in obtaining sugar fairly free of dust particles, and owing to the fact that the relative efficiency of the two had already been determined (38), the Palmer method alone was used to compare with the method of electrical precipitation. In using the former in the laboratory, a 4 cubic feet per minute rate seemed to be the most satisfactory and an effort was made to reduce the 10 cubic feet per minute rate of the high-tension machine to one more nearly equal that of the Palmer. Accordingly, the sliding valve was provided with a stop permitting only partial opening. With this arrangement, twenty-five anemometer tests, covering 3107 minutes, gave an average of 141.64 linear feet per minute with the collector in place, equivalent to 4.55 cubic feet per minute or 273 cubic feet per hour.

Third Series

At this rate, a new series of 50-mg. charges of dust which had been passed through a 100-mesh sieve was applied to the collector (Table III). The average return for the series was 96.113 per cent. The tube was cleaned with hot running water, and a test tube brush kept for this purpose. When finally rinsed inside with dust-free distilled water used for counting, boiling water was run over the outside and shaken off, the heat of the walls then drying the interior in a short time. If hung on the wire noose while still hot, the levitating effect of warm air caused by the heated collector was particularly noticeable. Differences in temperature of the metal, that of the rooms, and relative humidity were also found responsible under field conditions for a slow change in weight, as when taking the

TABLE IV. — ATMOSPHERIC CONDITIONS ENCOUNTERED IN FOURTH SERIES

No. of Test	T	T-T′	Relative Humidity %	Absolute Humidity gr. per cu. ft.	Barometer inches	No. of Test	T	T-T′	Relative Humidity %	Absolute Humidity gr. per cu. ft.	Barometer inches
3	72.5	16	35	2.97	....	39	74	9	61	5.53	29.93
4	74	18.5	28	2.08	....	40	80.5	14.5	45	4.92	29.94
5	75.5	11	54	5.05	....	41	67	14	37	2.67	30.58
6	71	16	33	2.71	....	42	70.5	13.5	42	3.35	30.28
7	71	16	33	2.71	....	43	72	12	49	4.16	30.14
8	74	18	29	2.17	....	44	72	14	42	3.57	30.05
9	74	18	29	2.17	....	45	74	15.5	38	3.44	30.08
10	69.5	14	40	3.09	....	46	68	12	46	3.44	30.36
11	74	14	43	3.89	....	47	69.5	13	43	4.09	30.5
12	67	17	26	1.95	....	48	66	9.5	55	3.85	29.91
13	68	17	27	2.76	....	49	73.5	12	50	4.39	30.09
14	68	16.5	29	2.17	....	50	81	21	27	3.04	30.02
15	70.5	17	29	2.38	....	51	83	23.5	24	2.87	29.98
16	75	16	37	3.46	....	52	74	14	43	3.89	30.01
17	72	14	42	3.57	....	53	69.5	9	59	4.55	30
18	76	13	48	4.63	....	54	71	9	60	4.94	30
19	77	19	29	2.88	30.18	55	73	10.5	55	4.83	29.92
20	70	15.5	34	2.71	30.42	56	79	11	57	6.04	29.92
21	71.5	15	37	3.04	30.31	57	78	14	46	4.72	30.04
22	78	12	53	5.44	29.91	58	80	14	47	5.13	29.89
23	74.5	13.5	45	4.07	29.93	59	83	27.5	12	1.43	29.8
24	70.5	15.5	34	2.71	29.95	60	76	13	48	4.63	29.96
25	75	19	27	2.52	30.12	61	75	12	51	4.77	30.18
26	69.5	14.5	37	3.63	30.36	62	74	15	39	3.52	30.17
27	70.5	15	36	2.87	30.31	63	87	18	39	5.27	29.9
28	72	13	45	3.82	29.85	64	91.5	22	31	4.72	29.84
29	70.5	14.5	38	3.03	29.96	65	88	15	48	6.69	30.18
30	71	16	33	2.71	30.16	66	99.5	21.5	38	7.3	30.15
31	73	16	35	3.07	30.14	67	89	14	51	7.32	30.28
32	74	10	26	2.35	30.24	68	98	19	43	8.02	30.25
33	72.5	14	42	3.57	29.74	69	89.5	11.5	59	8.47	30.23
34	64	11	47	3.08	29.9	70	97	20	39	7.07	30.2
35	64.5	11.5	45	2.95	30.09	71	81	10	61	6.87	30.18
36	61	10	49	2.91	30.12	72	64	7	65	4.26	30.53
37	61	4	78	4.63	29.95	73	66	6	71	4.97	30.45
38	65.5	11.5	46	3.11	30.13						

		Exceptions: No. 14, 40	No. 55, 42
Time of collecting, min.,	60		
Sample, cu. ft., high tension,	273	182	191.1
Sample, cu. ft., Palmer,	240	160	168

collector from cool dry surroundings to a warmer, more humid room, where determinations were made. In the laboratory, therefore, the collector hung about twenty minutes before weights were taken. In the practical tests of the apparatus, the rubber stoppered collector stood with its dust charge about fifteen minutes and was weighed after the outside was wiped with a clean towel. In this way any water condensed on the outer surface, together with dust, was removed. In the field work hot water was unobtainable. After the residue from shaking out the shell with distilled water had been weighed *in situ*, it was wiped out with a clean towel and reweighed preparatory to the next dust collection.

Attempts to adapt cover slips to a shell for retaining permanent dust records were unsatisfactory, and 10 c. c. samples of the 100 c. c. suspensions preserved instead. Glassware, after being cleaned and rinsed, was kept in a dessicator. A chemical washbottle was used to wash down the dust deposit, the suspension shaken twenty-five times, poured out, and the rinsings added to 100 c. c. Of this suspension two samples of 1 c. c. each were pipetted into Sedgwick Rafter slides and counted as recommended in Standard Methods (8).

Fourth Series

(Comparison of Palmer and high-tension machines under field conditions.)

For the purpose of comparing the Palmer and high-tension machines, a large manufacturing plant using rubber offered its resources, and all of the subsequent field tests were done in its various departments and buildings. On a small rubber-tired truck was erected a wooden housing, sufficiently large to accommodate all the apparatus necessary to complete the determinations (Fig. 1). The first two tests showed the advisability of doing weighing and counting where vibration was not so evident.

Atmospheric conditions varied within very wide limits (Table IV). Some processes were productive of sufficient dust to warrant the use of respirators. Some were provided with exhaust hoods over the machines, while others were not. It is felt that for the purpose of comparing the two collectors the conditions were, therefore, sufficiently varied to warrant the drawing of definite conclusions.

Weighing and counting were done in a room set aside in the plant for this purpose. Determinations of total solids, and organic and inorganic fractions were done in the Department of Preventive Medicine, Harvard Medical School, where the samples were carried in clean 4-ounce tin-foil capped bottles with paraffined corks. Because of the varied character, solubility and color of the dusts encountered and the difficulty of making suitable standards for each (38), turbidity tests were not undertaken. Gooch crucibles proved unsatisfactory and beginning with sample No. 16 were replaced by the more reliable porcelain capsule. In the field tests, the amount of material remaining on the high-tension collector after removing the sample was large enough to be weighable, and, beginning with No. 10, three weight determinations were made in each test. Take for example, sample No. 10:

Test, No. 10

Wt. collector after 60 min. run	119.0185 gm.
Wt. collector before	118.7465
Increase in wt. of tube	0.2720 gm. (Table VI, Col. 1)
Wt. collector after 60 min. run	119.0185 gm.
Wt. collector after sample was rinsed out	118.7675
Wt. of sample (suspension)	0.2510 gm. (Table VI, Col. 2)
Sediment in 50 c.c. of suspension	.1045 gm.
	2
Wt. of total in suspension	0.2090 gm. (Table VI, Col. 4)
Increase in wt. of tube	0.2720 gm.
Suspension sample	0.2510
Loss (left in tube)	0.0210 (Table VI, Col. 3)
Suspension sample	0.2510 gm.
Sediment in 50 c.c. sample	0.2090
Loss	0.0420 (Table VI, Col. 5)

The factors responsible for a gradual decrease in tube weight were not evidenced so far as the collecting surface was concerned, for the interior presented as mirror-like an appearance at the end of seventy-one tests as it did in the beginning. It is possible, however, that a small amount of inter-reaction occurred between the chemical dusts collected and the metal of the shell, which would result in loss in weight. Counts are reported as actually observed because the

figures (Table V) were used as a basis for percentage comparison. A correction was made for the particle content of the water used.

For convenience sake, the data of the seventy-one tests made in this series are tabulated together. Save when otherwise noted (Table IV), all tests were one hour long by stop-watch. The resulting weight figures for the high-tension machine were reduced proportionately to give equivalent values for 240 cubic feet per minute (Tables VI, VII). Talc room tests, Nos. 3–7 inclusive, were made in a room 36×45×11 feet, in which there were eight cleaning hoods and two tumblers, only one of which was in use. The number of men at work varied from two to six. The tumbler gave rise to a large amount of talc dust. Tests Nos. 8 and 9 were taken in a blasting room, back of five operatives who were talc-blasting canvas shoes and steel heel moulds. A sand-blasting machine also added its quota of dust. This irregularly shaped room was about 48×18×11 feet. Door and window conditions varied so much daily during the entire series that they were not summarized in any location.

One of the most striking facts observed in this series, and found continually afterwards in these tests, was the dissimilarity of the particles as shown in the two suspensions. This will be commented on later.

The next stand was in the carpenter shop near the planer used for surfacing cutting blocks. The collector truck was placed nearby. The operator, believing that the writer was after dust, cut his blocks dry, with a perfect rain of particles thrown against the collectors. The Palmer bulb opening upward, much adventitious heavy material settled in, giving the Palmer weights and counts higher values than those of the high tension. This dust was composed of wood fibre, whiting, talc, cloth fibre, etc., and in common with the carpenter shop series made later in the same room, but in a different location, tended to form a foamy suspension.

Because of the tremendous vibration only three tests were made in one of the main rooms of the factory, near a battery of cutting machines used to stamp out soles and other shoe parts. The dust here encountered was mostly a crude grade of whiting, which was liberally thrown on the cloth to prevent sticking of the layers in the cutter.

The rag house was 24 × 24 feet, and the bin room on the first floor where the tests were made was 12 feet high. Here were eight bins fed one at a time by a bucket chute. The tests were made during the shredding of waste cloth stock. The dust varied with the material fed, invariably being fibrous, and sometimes including inorganic substances as well.

The carpenter shop visited (63 × 41 × 13 feet) contained a Daniels planer, band saw, grind and emery wheels, surface and thickness planers, mortising machine and cross-cut saw, which worked as the need for them arose. Since only new stock was used in this shop, the dust encountered for the most part was from wood, save when cutting blocks were surfaced dry on the Daniels planer.

The foundry was in a building 62 × 80 × 27 feet, wherein the activities of the twenty-seven men employed were divided between nine moulding benches, a core-breaking pen, aluminum and bronze furnaces and core-baking ovens. The collectors were installed near the core-breaking pen where most of the dust present originated. The number of men working here varied from two to five.

The grinding room measured 79 × 31 × 13 feet, and contained four double-end naggers, three felt wheels coated with abrasive, a grinder head, four single and two gang drills. The naggers and abrasive wheels were fitted with downward suction apparatus. Many of the departments in which the air was sampled were fitted with exhaust hoods of various types. In this department aluminum, bronze and brass castings, chiefly boot and shoe forms, were trimmed to shape. Tallow liberally applied to the abrasive wheels tended to eliminate metallic dust. The dust sampled was similar to that of the foundry and was due to imperfectly removed cores.

The compound rooms tested differed in their shape, amount of ventilation, number of bins drawn upon, and amount and character of the substances used in making rubber stock. The dust encountered was essentially the same in both rooms, and similar to that encountered in the mixing room. The first compound room was 79 × 20 × 11 feet; the second, 36 × 38 × 16 feet; while the mill room was 100 × 79 × 12 feet and contained sixteen mills in which rubber and other substances were mixed together.

TABLE V. — NUMBER AND DISTRIBUTION OF SIZE OF PARTICLES PER CUBIC FEET OF AIR

Test No.	High Tension 1	High Tension 2	High Tension 3	High Tension 4	High Tension 5	Palmer 1	Palmer 2	Palmer 3	Palmer 4	Palmer 5	Total per Cu. Ft. H	Total per Cu. Ft. P	Ratio H = P	Ratio P = H
3	....	586	7,326	36,630	++	.	166	3,999	24,332	++	44,514	28,497	156.3	63.9
4	....	1,025	2,930	19,926	++	.	166	1,333	17,332	+	23,881	18,831	126.8	78.8
5	....	146	732	10,109	++			333	6,499	+	10,987	6,832	160.8	62.1
6	....	2,930	36,630	133,333	++			33,333	108,320	+	172,890	141,652	122	81.9
7	....	2,930	41,020	208,050	++		3,333	36,666	149,999	+	252,000	189,998	132.6	75.3
8	....	8,790	43,950	395,600	++		6,666	28,333	206,650	+	448,340	251,649	178.1	56.1
9	....	7,320	26,370	246,150	++		3,333	18,333	109,999	+	279,840	131,665	212.5	47
10	293	146	6,153	23,882	++	166	2,166	5,499	29,498	+	30,474	37,329	81.6	122.4
11	3,333	5,666	14,832	40,331	++	439	5,567	15,384	54,212	+	64,162	75,602	84.8	117.8
12	146	1,611	7,619	80,439	++		166	8,166	65,997	+	89,815	74,329	120.8	82.7
13	.	8,790	39,560	325,270	++		6,666	21,666	118,320	+	373,620	145,662	254.7	39.2
14	.	10,485	39,546	290,000	++		7,500	20,000	230,000	+	227,090	184,998	147	81.4
15	5,860	13,180	44,020	445,420	++		6,666	21,666	153,320	+	505,480	181,652	278.2	35.9
16	586	1,172	3,996	17,435	+		1,333	1,999	6,499	+	23,189	9,831	235.8	42.3
17	..	586	1,465	13,919	+		666	1,166	4,666	+	15,970	6,498	245.7	40.6
18	2,551	4,249	11,868	58,168	++	833	1,833	2,333	18,332	+	76,836	23,331	329.3	30.3
19	..	293	4,542	150,769	++		999	3,999	23,665	+	155,604	28,663	542.8	18.4
20	2,051	2,930	3,076	28,571	++		1,166	1,833	6,999	+	36,628	9,998	336.3	27.2
21	146	879	2,490	26,666	++		666	2,833	11,499		30,181	14,998	201.2	49.6
22	1,465	2,051	5,128	27,106	++	333	1,333	23,33	6,666		35,750	10,665	335.2	29.8
23	293	293	586	7,032	+	166		500	1,166	+	8,204	1,832	447.8	22.3
24	146	2,783	9,670	36,776	++		1,666	2,833	4,833	+	49,375	4,332	529	18.9
25	146	3,663	10,550	50,402	++	166	2,166	5,500	30,165	+	60,761	37,997	159.9	62.5
26	146	3,809	8,791	35,164	++		1,333	5,333	19,832	++	47,910	26,498	180.8	55.3
27	1,460	8,790	51,280	347,250	++		8,333	20,000	258,320	+	40,8780	286,653	142.6	70.1
28	...	4,688	10,256	38,388	++	166	1,666	6,666	39,665	+	53,332	48,163	110.7	90.3
29	439	2,051	8,351	35,314	++	333	2,000	3,166	7,333	+	46,152	12,832	359.6	27.8
30	..	586	4,395	13,772	++		500	2,000	3,166	+	18,753	5,666	330.9	30.2
31	1,904	5,128	8,500	31,941	++	833	1,833	6,000	22,000	+	47,473	30,666	154.8	64.5
32	146	2,051	7,179	30,622	++	333	1,500	3,000	19,665	+	39,998	24,498	163.2	61.2
33	146	3,956	7,326	23,296	++		2,000	3,500	11,166	+	34,724	16,666	208.3	47.9
34	....	3,956	17,875	177,142	+++		2,000	10,000	143,160	++	198,973	155,160	128.2	77.9
35	....	16,110	52,740	546,510	++		6,666	23,333	515,000	+	615,360	544,999	112.9	88.5
36	....	8,790	26,370	199,260	+++	.	5,000	11,666	145,000	++	234,420	161,666	145	68.9
37	1,460	5,860	29,300	222,710	++			10,000	158,320	+	259,330	168,320	154	64.9
38	293	2,930	6,007	58,461	+++		833	3,666	42,000	++	67,691	46,499	145.5	68.6
39	..	1,025	4,836	44,835	++		333	1,333	26,000	++	50,696	27,666	183.2	54.5
40	146	586	3,076	33,553	+++		333	1,000	20,332	++	37,361	21,665	172.4	57.9
41	..	732	3,369	44,981	+++		166	2,833	24,332	++	49,082	27,331	175.5	51.6
42	....	439	2,783	27,252	++		333	1,333	17,000	+	30,474	18,666	163.2	61.2
43	293	146	1,758	20,219	++	.		833	10,000	+	22,416	10,833	206.9	48.3
44	..	586	2,051	33,553	++		166	1,000	16,666	+	36,190	17,832	202.9	49.2
45	439	732	2,051	23,882	++		500	1,666	15,166	+	27,204	17,332	156.3	63.9
46	....	1,025	1,904	42,930	++			1,000	18,165	++	45,859	19,165	239.2	41.8
47	....	146	1,465	30,066	++	.	166	1,000	18,666	++	31,647	19,832	159.5	62.6
48	....	439	3,663	39,560	++		166	1,166	14,332	++	43,662	15,664	278.7	35.8
49	....	586	2,637	27,836	++	166	166	1,166	14,000	+	31,059	25,398	122.2	81.7
50	....	1,904	13,919	106,666	++	.	500	7,000	61,500	..	122,489	69,000	177.5	56.3
51	439	2,197	11,428	108,868	++	.	666	6,000	59,830	..	122,932	66,496	184.8	54
52	....	879	1,904	30,915	++	.	166	1,000	24,165	..	53,698	25,331	133	75.1
53	....	293	2,490	29,150	++		166	1,833	19,165	.	32,233	21,164	152.3	65.6
54	....	1,318	3,516	93,040	++	..	666	4,000	29,000	.	97,874	33,666	290.7	34.3
55	....	1,255	3,976	79,115	++	.	238	4,522	62,118	..	84,346	66,878	126.1	79.2
56	146	....	2,344	25,347	++	166	..	2,333	9,832	.	27,837	12,331	225.7	44.2
57	146	732	6,593	106,813	++		333	3,333	52,000		114,284	55,666	205.3	48.7
58	....	1,025	5,274	64,322	++		166	1,666	31,332	.	70,621	33,164	212.9	46.9
59	....	1,465	2,637	50,842	++	.	1,166	3,000	24,000	.	54,944	28,166	195	51.2
60	146	2,197	7,032	69,303	++	...	833	3,166	27,165		78,678	31,164	252.4	39.6
61	146	586	5,567	117,655	++	...	333	6,333	75,000	.	123,954	81,666	151.7	65.8
62	....	439	5,128	38,534	+	..	166	2,500	21,165	..	44,401	23,831	185	54
63	293	2,051	10,695	115,457	++	.	333	3,333	88,830		128,496	92,496	138.9	71.9
64	146	2,344	12,014	113,259	++	...	833	5,333	57,164	+	127,763	63,330	201.7	49.5
65	293	1,758	4,835	40,293	++	.	333	1,166	10,000	..	47,179	11,499	410.2	24.3
66	....	732	4,542	24,615	++	.	166	2,166	19,665	..	29,889	21,997	135.8	73.5
67	146	879	3,223	44,835	++	.	333	1,833	26,000	..	49,083	28,166	174.2	57.3
68	....	1,025	5,567	81,318	++	...	166	3,666	40,331	..	87,910	44,163	199	50.2
69	146	2,196	16,555	96,262	++	...	1,500	6,666	37,500	..	115,159	45,666	252.1	39.6
70	146	3,516	17,289	96,117	++	166	1,833	7,000	62,830	..	117,068	71,829	162.9	61.3
71	293	2,637	15,677	35,164	++	...	2,166	9,666	59,500	..	53,771	71,332	75.3	132.6
72	293	879	5,128	42,783	++	...	333	2,166	23,832	..	49,083	26,331	186.4	53.6
73	....	1,172	4,395	41,025	++	...	833	2,833	19,332	..	46,592	22,998	202.5	49.3

Discussion of Results

In Table V, the two suspensions were made up to 100 c. c. In counting some of heavier dusts 10 c. c. of this, in turn, was again diluted to 100 c. c. The proper factors for samples 14 and 55 were used, these being smaller (see Table IV) than the others in the series. In Class 5 (see Final Report on Standard Methods (8)) a single plus indicates the presence of many particles smaller than Class 4, a double plus means their marked concentration, while a triple plus indicates their very marked concentration. The percentage ratio of the total count per cubic foot for each test is commented on in the summary.

Due to factors not determined, the particulate matter in Palmer suspensions tends to form masses in which, by indirect lighting, different colored particles may be distinctly seen, which a similar sample collected by the electrical method will show as separate entities in the slide. This was particularly true of dusts in the compounding rooms examined. The observation is not confined to any one size of particles. It seemed, however, that the class covered by Column 5 tended to form aggregates to a greater numerical degree than did those of larger sizes. In counting, even where masses observed in Palmer suspensions were undoubtedly made up of smaller particles, they were regarded as single particles and classed according to their mass. Suspensions collected by other observers using the Palmer machine show in the reported photo-micrographs the same character of clumping so far as can be determined from the reproductions alone (39). As observed by the writer, the stippled effect brought about by these particles was much greater in the high-tension samples than can be accounted for by the greater number of cubic feet of the latter.

In the writer's experience the frequency with which this observation was met warrants the belief that counts made on Palmer machine suspensions, particularly so far as size classification is concerned, must be accepted with some reserve. For this reason also a comparison of percentage distribution of particles according to size would offer data of questionable value in this report.

Of the remainder of the original 100-c. c. suspensions, 50 c. c. were pipetted after thorough shaking into porcelain crucibles and evaporated to dryness This method of transferring material is felt to be responsible for the figures in Table VI, Column 5. It is difficult to withdraw, even with careful manipulation, a representative sample because of the difference in weight of particles in the same sample, many of which tend to settle quickly and be drawn into the pipette. This would account for the occasional instances where the total sediment figures obtained by doubling the weight of sediment in the 50 c. c. high-tension sample (Column 4) apparently exceeded the weight of sediment in the 100 c. c. samples (Column 2), or even that actually collected (Column 1). These experimental errors are indicated by plus signs in Column 5.

The figures in Columns 9, 10, and 11, Table VI, are twice those obtained from the Palmer sediment 50 c. c. sample. Those of Column 4 are twice the amounts found in the 50 c. c. high-tension sample. These figures and the O and I values as determined from the crucible weights, were multipled by the fraction 240 ÷ 273 to get the figures of Columns 6, 7, and 8, which are thus comparable with the Palmer figures. The proper correction was made for tests 14 and 55 (Table IV). The percentage relationship in both H and P figures of inorganic residue (I) to total sediment (S) in Columns 12 and 13 reveal how closely the larger quantities of dust collected by high tension corresponded to that obtained by the Palmer method.

The dried crucible was ignited over a blast lamp and the residue reported as inorganic (I) and the loss of weight as organic (O). While this procedure may have reduced possible sulphates and carbonates to oxids, the loss therefrom not to be strictly regarded as from organic material, the fact that both sediments were collected at the same time and treated similarly is regarded as warranting their being reported as comparable fractions.

In Table VII are compared the total sediment, organic and inorganic sediments in milligrams per cubic foot of air, together with percentage comparisons. The figures were obtained by dividing those in Columns 6 to 11 inclusive, Table VI, by 240, and expressing the results in milligrams.

One observed factor of possible importance in explaining the difference in results of the use of the two machines is the different way in which each would react to fluctuations in current. A slight drop in

TABLE VI.—COMPARISON OF HIGH-TENSION (H) AND PALMER (P) TOTAL (S) ORGANIC (O) AND INORGANIC (I) SEDIMENT WEIGHTS IN GRAMS

	Actual Weights, High-Tension Tests					Sediment Collected in 240 Cu. Ft. Air						Ratio I to S	
						High Tension			Palmer				
	Tube Weight Increase	Water Sample	Difference Cols. 1 & 2	Total Sediment (S)	Difference Cols. 2 & 4	S	O	I	S	O	I	H	P
No.	1	2	3	4	5	6	7	8	9	10	11	12	13
3	.0243	....	....	.02	....	.0087	.0028	.0059	.0048	.0026	.0022	67.8	45.8
4	.0177	....	....	.0104	....	.0045	.002	.0025	.0045	.0012	.0033	55.5	73.3
5	.0123	....	....	.0086	....	.0037	.0015	.0021	.0032	.0013	.0019	56.7	59.3
6	.1415	....	....	.1068	....	.0469	.0036	.0433	.0349	.0037	.0322	92.3	92.2
7	.1462	....	....	.1164	....	.0511	.0043	.0468	.0326	.0026	.03	91.5	92
8	.257	....	....	.2048	....	.09	.0027	.0872	.0593	.0072	.0521	96.8	87.8
9	.137	....	....	.1186	....	.0521	.0072	.0448	.042	.0052	.0368	85.9	87.6
10	.272	.251	−.021	.209	−.042	.0918	.0527	.0391	.1193	.0596	.0597	42.5	50
11	.133	.1055	−.0275	.0946	−.0109	.0415	.0409	.0006	.0515	.0506	.0009	1.4	1.7
12	.1415	.1325	−.009	.1008	−.0317	.0443	.0023	.0419	.0266	.0009	.0257	94.5	96.6
13	.2255	.2188	−.0067	.1994	−.0194	.0876	.0123	.0752	.0322	.0013	.0319	85.8	99
14	.2383	.2385	−.0058	.217	−.0155	.1429	.0265	.1164	.078	.0063	.0732	81.4	92
15	.345	.338	−.007	.2976	−.0404	.1308	.0139	.1168	.0597	.0065	.0532	89.2	89.1
16	.0278	.0243	−.0035	.023	−.0013	.0101	.0082	.0018	.0035	.0018	.0017	17.8	48.5
17	.017	.0115	−.0055	.011	−.0005	.0057	.0031	.0025	.0022	.0015	.0007	43.8	31.8
18	.0455	.0437	−.0018	.043	−.0007	.0189	.016	.0028	.0087	.0064	.0023	14.8	26.5
19	.0858	.0783	−.0075	.0766	−.0017	.0336	.0253	.0083	.0137	.0042	.0095	24.7	69.3
20	.0338	.0278	−.006	.0318	+.004	.0148	.0099	.0049	.0057	.0044	.0013	33.1	22.8
21	.0205	.0188	−.0017	.0186	−.0002	.0081	.0055	.0026	.0036	.0014	.0022	32.3	61.1
22	.0412	.0412	....	.0366	−.0046	.016	.014	.002	.0062	.0061	.0001	12.5	1.6
23	.0062	.0047	−.0015	.0056	−.0009	.0025	.0014	.001	.0011	.0009	.0002	40	18.1
24	.0305	.0245	−.006	.022	−.0025	.0096	.0089	.0007	.0069	.0057	.0012	7.2	17.3
25	.0417	.0307	−.011	.027	−.0037	.0118	.0089	.0029	.01	.0084	.0016	24.5	16
26	.0235	.0156	−.0075	.0164	−.0004	.0072	.0066	.0005	.0056	.0054	.0002	6.9	3.5
27	.251	.2372	−.0138	.2306	−.0066	.1013	.0522	.0493	.0594	.0292	.0302	48.6	50.8
28	.042	.041	−.001	.0276	−.0134	.0121	.0101	.0019	.0114	.0092	.0022	15.7	19.3
29	.03	.03	....	.0248	−.0052	.0109	.0098	.001	.0065	.0056	.0009	9.1	13.8
30	.021	.014	−.0075	.0124	−.0016	.0054	.0045	.0008	.0047	.003	.0017	14.8	36.1
31	.043	.0385	−.0045	.043	+.0045	.0184	.0168	.002	.0116	.01	.0016	10.8	13.8
32	.02	.016	−.004	.017	+.001	.0074	.0059	.0014	.0042	.0025	.0017	18.9	40.4
33	.0275	.0275	....	.0222	−.0052	.0097	.0082	.0014	.0044	.0038	.0006	14.4	13.6
34	.1145	.1105	−.004	.11	−.0005	.0483	.0127	.1356	.0303	.0086	.0217	73.7	71.6
35	.167	.16	−.007	.1512	−.0088	.0664	.0175	.0488	.0438	.0135	.0303	73.4	69.1
36	.096	.0915	−.0045	.089	−.0025	.0391	.0104	.0286	.0253	.0069	.0184	73.1	72.7
37	.162	.1585	−.0035	.1478	−.0107	.0649	.0166	.0483	.0317	.0071	.0246	74.4	77.6
38	.057	.054	−.003	.053	−.001	.0232	.0061	.0171	.0144	.0037	0107	73.7	74.3
39	.022	.022	....	.0216	−.0004	.0094	.0042	.0052	.0083	.003	.0053	55.3	63.8
40	.017	.017	....	.0188	+.0018	.0082	.0021	.006	.0057	.0029	.0028	73.1	49.1
41	.0265	.0275	+.001	.0292	+.0017	.0128	.0049	.0079	.0077	.0032	.0045	61.7	58.4
42	.0163	.0148	−.0015	.0168	+.002	.0073	.0038	.0035	.0051	.0025	.0026	27.9	50.9
43	.0105	.008	−.0025	.009	+.001	.0039	.0021	.0018	.0017	.0006	.0011	46.1	64.7
44	.0135	.013	−.0005	.0156	+.0026	.0068	.0034	.0034	.0056	.0026	.003	50	53.5
45	.0145	.012	−.0025	.0162	+.0042	.0071	.0035	.0036	.0049	.0027	.0022	50.6	44.8
46	.0188	.0173	−.0015	.019	+.0023	.0083	.0034	.0049	.0052	.0021	.0031	59	59.6
47	.011	.009	−.002	.01	+.001	.0043	.0022	.0021	.0036	.0018	.0018	48.8	50
48	.018	.0168	−.0012	.0166	−.0002	.0072	.0033	.0039	.0023	.0012	.0011	54.1	46.8
49	.0332	.0274	−.0058	.0246	−.0028	.0108	.0058	.005	.005	.0017	.0033	46.2	66
50	.0686	.047	−.0216	.0424	−.0046	.0186	.0164	.0021	0123	.0033	.009	11.2	73.1
51	.058	.048	−.01	.0282	−.0198	.0211	.0086	.0125	.0116	.004	.0076	59.4	65.5
52	.0208	.0161	−.0047	.02	+.0039	.0087	.0045	.0042	.0016	.0024	.0022	48.2	47.8
53	.036	.0336	−.0024	.0302	−.0034	.0132	.0087	.0045	.0054	.0019	.0035	34	64.8
54	.0592	.0554	−.0038	.0522	−.0032	.0229	.0109	.0119	.0116	.0039	.0077	51.9	66.3
55	.0456	.0376	−.008	.0366	−.001	.0228	.0106	.0122	.0177	.0074	.0102	53.7	58
56	.0264	.0212	−.0052	.0202	−.001	.0088	.0054	.0034	.004	.0028	.0012	38.6	30.0
57	.0462	.0402	−.006	.0574	+.0172	.0252	.0078	.0174	.0099	.0031	.0068	69	68.6
58	.0365	.0316	−.0049	.0294	−.0022	.0129	.0078	.005	.007	.0031	.0039	38.7	55.7
59	.0312	.0312	....	.0296	−.0016	.013	.0068	.0061	.0075	.0033	.0042	46.9	56
60	.0384	.035	−.0034	.0268	−.0082	.0161	.0065	.0096	.0082	.0035	.0047	59.6	57.3
61	.0705	.064	−.0065	.0618	−.0022	.0271	.0081	.0189	.0155	.004	.0115	69.7	74.1
62	.0296	.0268	−.0028	.028	+.0012	.0123	.0072	.005	.0076	.0022	.0054	40.6	71
63	.0968	.087	−.0098	.0882	+.0012	.0387	.0126	.0261	.016	.005	.011	67.4	68.7
64	.0622	.06	−.0022	.0582	−.0018	.0255	.0109	.0145	.0137	.0057	.008	56.8	58.3
65	.019	.0178	−.0012	.015	−.0028	.0065	.0022	.0043	.0054	.0024	.003	66.1	55.5
66	.0122	.012	−.0002	.0186	+.0066	.0081	.0034	.0047	.0039	.0023	.0016	58	41
67	.0158	.0048	−.001	.0172	+.0024	.0075	.0025	.005	.0067	.0038	.0029	66.6	42.2
68	.0288	.0263	−.0025	.027	+.0007	.0118	.0035	.0083	.0071	.0031	.004	70.3	56.3
69	.0568	.053	−.0038	.056	+.003	.0246	.0094	.0151	.0131	.0061	.007	61.3	53.4
70	.0914	.0884	−.003	.0894	+.001	.0392	.0167	.0225	.0203	.0092	.0111	57.3	54.6
71	.1005	.097	−.0035	.092	−.005	.0404	.0257	.0146	.025	.0162	.0088	36.1	35.2
72	.0182	.0177	−.0005	.0198	+.0021	.0087	.004	.0046	.0055	.0028	.0027	52.8	49
73	.0166	.0145	−.0021	.014	−.0005	.0061	.0019	.0042	.0056	.0025	.0031	68.8	55.4

TABLE VII.—TOTAL (S), ORGANIC (O), AND INORGANIC (I) RESIDUE, HIGH TENSION (H) AND PALMER (P), IN MILLIGRAMS PER CUBIC FOOT OF AIR

	S				O				I			
No.	H	P	H = % P	P = % H	H	P	H = % P	P = % H	H	P	H = % P	P = % H
3	.0362	.02	181.0	55.2	.0116	.0108	107.4	93.1	.0246	.0091	270.3	36.9
4	.0174	.0187	93	107.4	.0083	.005	166	60.2	.0104	.0137	75.9	131.7
5	.0155	.0133	116.5	85.8	.0062	.0054	114.8	87	.0087	.0079	110.1	90.8
6	.1954	.1454	134.3	74.4	.015	.0154	97.4	102.6	.1804	.1341	134.5	74.3
7	.2129	.1358	156.7	63.7	.0179	.0108	165.7	60.3	.195	.125	156	64.1
8	.375	.247	151.8	65.8	.0112	.03	86.1	116	.3633	.217	167.4	59.7
9	.217	.175	124	80.6	.03	.0216	138.8	72	.1866	.1533	121.7	82.1
10	.3825	.497	76.9	129.9	.2195	.2483	88.4	113.1	.1629	.2487	65.5	152.6
11	.1729	.2145	80.6	124	.1704	.2108	80.8	123.7	.0025	.0037	67.5	148
12	.1845	.1108	166.5	60	.0095	.0037	256.7	38.9	.1745	.107	163	61.3
13	.365	.1341	272.1	36.7	.0512	.0054	948.1	10.5	.3133	.1329	235.7	42.4
14	.523	.3312	157.9	63.3	.0972	.0266	365.4	27.3	.4263	.305	139.7	71.5
15	.545	.2487	219.1	46.6	.0579	.027	214.4	46.6	.4866	.2216	219.5	45.5
16	.042	.0145	289.6	34.5	.0341	.0075	454.6	21.9	.0075	.007	107.1	93.3
17	.0237	.0091	260.4	38.3	.0129	.0062	208	48	.0104	.0029	358.6	27.8
18	.0787	.0362	217.4	45.9	.0666	.0266	250.3	39.9	.0116	.0096	120.8	82.7
19	.14	.057	245.6	40.7	.1054	.0175	602.2	16.6	.0345	.0395	87.3	114.4
20	.0616	.0237	259.9	38.4	.0412	.0183	225.1	44.4	.0204	.0054	377.7	26.4
21	.0337	.015	224.6	44.5	.0229	.0058	394.8	25.3	.0108	.0091	118.6	84.2
22	.0666	.0258	258.1	38.7	.0583	.0254	229.5	43.5	.0083	.0004	2075	4.8
23	.0104	.0045	231.1	43.2	.0058	.0037	156.7	63.7	.0041	.0008	512.5	19.5
24	.04	.0287	139.3	71.7	.037	.0237	156.1	64	.0029	.005	58	172.4
25	.0491	.0416	118	84.7	.037	.035	105.7	94.5	.012	.006	181.8	55
26	.03	.0233	128.7	77.6	.0275	.0225	122.2	81.8	.0204	.0008	2550	3.9
27	.422	.2475	170.5	58.6	.2175	.1216	178.8	55.9	.2054	.1258	163.2	61.2
28	.0504	.0475	106.1	94.2	.042	.0383	109.6	91.1	.0079	.0091	86.8	115.1
29	.0454	.027	168.1	59.4	.0408	.0233	175.1	57.1	.0041	.0037	110.8	90.2
30	.0225	.0195	115.3	86.6	.0187	.0125	149.6	68.8	.0033	.007	41.7	212.1
31	.0766	.0483	158.5	63	.07	.0416	168.2	59.4	.0083	.0066	125.7	79.5
32	.0308	.0175	176	58.8	.0245	.0104	235.5	42.4	.0058	.007	82.8	120.6
33	.0404	.0183	220.7	45.2	.0304	.0158	192.4	51.9	.0058	.0025	232	43.1
34	.2012	.1262	159.4	62.7	.0529	.0358	147.7	67.6	.1483	.0904	165	60.9
35	.2766	.1825	151.5	65.9	.0729	.0561	129.9	76.9	.2033	.1262	161	62
36	.1629	.1054	154.5	64.7	.0433	.0287	150.8	66.2	.1191	.0766	155.4	64.3
37	.2704	.132	204.8	48.8	.0691	.0295	234.2	42.6	.2012	.1025	196.2	50.9
38	.0966	.06	161	62.2	.0254	.0154	164.9	60.6	.0712	.0419	169.9	58.8
39	.0391	.0345	113.3	88.2	.0175	.0125	140	71.4	.0216	.022	98.1	101.8
40	.0341	.0237	143.8	69.5	.0087	.012	72.5	137.9	.0291	.0116	250.8	39.8
41	.053	.032	165.6	60.3	.0204	.0133	153.3	65.1	.0329	.0187	175.9	56.8
42	.0304	.0212	143.3	69.7	.0158	.0104	151.9	65.8	.0145	.0108	134.2	74.4
43	.0161	.007	203	43.4	.0087	.0025	348	28.7	.0074	.0045	164.4	60.8
44	.0283	.0233	121.4	82.3	.0141	.0108	130.5	76.5	.0141	.0124	113.7	87.9
45	.0295	.0204	144.6	69.1	.0145	.0112	129.4	77.2	.0149	.0091	163.7	61
46	.0345	.0216	159.7	62.6	.0141	.0087	162	61.7	.0204	.0129	158.1	63.2
47	.0179	.015	119.3	83.7	.0091	.0075	121.3	82.4	.0087	.0074	117.5	85
48	.03	.0095	315.7	31.6	.0137	.005	274	36.4	.0162	.0045	360	27.7
49	.045	.0208	216.3	46.2	.0241	.007	344.2	29	.0208	.0137	151.8	65.8
50	.0775	.0512	151.3	66	.0681	.0137	497	20.1	.0087	.0374	23.2	429.8
51	.0879	.0483	181.9	54.9	.0358	.0166	215.6	46.3	.052	.0316	164.5	60.7
52	.0362	.0191	189.5	52.7	.0187	.0099	188.8	52.9	.0174	.0091	191.2	52.2
53	.055	.0225	244.4	40.9	.0362	.0079	458.2	21.8	.0187	.0145	128.9	77.5
54	.0954	.0483	197.5	50.6	.0454	.0165	275.1	36.3	.0495	.032	154.6	64.6
55	.0878	.0775	113.2	88.2	.0406	.0325	124.9	80	.0472	.045	104.8	95.3
56	.0366	.0166	220.4	45.3	.0224	.0116	193.1	51.7	.0141	.0049	287.7	34.7
57	.105	.0412	254.8	39.2	.0324	.0291	111.3	89.8	.0724	.0283	255.8	39
58	.0537	.0291	184.5	54.1	.0324	.0291	111.3	89.8	.0208	.0162	128.3	77.8
59	.0541	.0312	173.3	57.6	.0283	.0137	206.5	48.4	.0254	.0174	145.9	68.5
60	.067	.0341	196.4	50.8	.027	.0145	186.2	53.7	.0399	.0195	204.6	48.8
61	.1129	.0645	175	57.1	.0337	.0166	203	49.2	.0787	.0479	164.3	60.8
62	.0512	.0316	162	61.6	.0299	.0091	328.5	30.4	.0208	.0224	92.8	107.6
63	.1612	.0666	242	41.3	.0524	.0208	251.9	39.6	.1087	.0457	237.8	42
64	.1062	.057	186.3	53.6	.0454	.0237	191.5	52.2	.0604	.0333	181.3	55.1
65	.027	.0225	120	83.3	.0091	.0099	91.9	108.7	.0179	.0124	144.3	69.2
66	.0337	.0162	208	48	.0141	.0095	148.4	67.3	.0195	.0066	295.4	33.8
67	.0312	.0279	111.8	89.4	.0104	.0158	65.8	151.9	.0208	.012	173.3	57.6
68	.0491	.0295	166.4	60	.0145	.0129	112.4	88	.0345	.0166	207.8	48.1
69	.1025	.0545	188	53.1	.0391	.0254	153.9	64.9	.0629	.0291	216.1	46.2
70	.1633	.0845	193.2	51.7	.0695	.0383	181.4	55.1	.0937	.0462	202.8	49.3
71	.168	.1041	161.3	61.9	.107	.0675	158.5	63	.0608	.0366	166.1	60.1
72	.0362	.0229	158	63.2	.0166	.0116	143.1	69.8	.0191	.0112	170.5	58.6
73	.0254	.0233	109	91.7	.0079	.0104	75.9	131.6	.0175	.0129	135.6	73.7

potential would cause a drop in the Palmer manometer gauge, often as high as ½ cubic foot per minute, whereas the tone of the high-tension fan motor would hardly be altered, nor would, moreover, such a slight line drop show itself in the intensity of the corona discharge.

It has been shown that some of the finer particles may pass through the Palmer apparatus. In the only efficiency tests reported (38), carmine and pearl dust were used. Tests with the latter covered a period of about five minutes, in which time but little of the pearl dust used would have a chance to become fixed to the inside of the glass with resulting loss, as observed in runs of an hour's duration. It is to be expected that pearl dust, insoluble in water, and containing particles as large as those passing through bolting cloth would, under the conditions reported, be almost all washed out in recovery. It is felt, therefore, that these tests of the efficiency of the Palmer apparatus are not sufficiently conclusive.

It is possible on the contrary to determine the efficiency of a high-tension collector through the application of artificial dust charges by noting the increase in weight of the collector. It is further possible through using aluminum foil instead of tubing to reduce the weight of the collector as compared to the dust charge (20). Again, after all the sediment that can be so removed has been washed down by a wash bottle with a fine jet and the collector dried, the weight of material left on the walls can be determined. The ratio between the original increase in weight of the tube, the reweigh figure just referred to and the weight cleaned, will give an accurate idea as to what percentage of dust actually present in the air was collected, and what was lost.

It is comparatively an easy matter to produce water relatively free of particulate matter by distillation with subsequent settling or filtration through a Berkefeld candle. For use in the Palmer apparatus but few liquids approach it in availability or ease of preparation. On the other hand, water is of questionable value in making Palmer tests in low temperatures, as has been the writer's experience. This objection is not encountered with the use of the high-tension method.

There is a tendency on the part of the Palmer machine to subject the passing air to irregular treatment as shown by the variable size of the air bubbles. While such a device would introduce another factor to be reckoned with, and hence be of disadvantage, it is suggested that the incoming air might to advantage be broken up into smaller bubbles by passing it through a perforated porcelain plate. It may also be possible that the intermittent passage of air through the Palmer bulb may not carry with it the less responsive particles of dust due to their greater inertia, whereas through the high-tension collector the passage of air with its dust content is smooth and continual.

Another factor of importance is the personal element necessary in keeping the manometer gauge registering a uniform rate of air passage through the bulb. Slightly more than 40 c. c. (15) dust-free distilled water is necessary to cause the fan to register 4 cubic feet per minute at the start. This quickly tends to decrease, requiring the frequent addition of small portions of water. Several tests were discarded because of certain mechanical defects encountered in the apparatus.

The only trouble encountered in the maintenance of the high-tension apparatus used was the occasional replacing of brushes and truing the commutator. After several days' run the commutator segments became pitted at points corresponding with the flow of current to the rectifier and in this condition commutator arcing was noted, with very marked reduction in the intensity of the corona.

The factors responsible for the disparity of results obtained in using the two machines side by side were not determined. In part, at least, those already referred to, which were encountered in the progress of this work, may be responsible.

Summary of Fourth Series

Table VIII summarizes the seventy-one tests, reported by departments and buildings, and indicates something of their relative dustiness. Columns 3 and 4 contain the total amounts of dust collected for each department (Col. 1) for the number of tests conducted therein (Col. 2). Columns 8, 9, and 10 indicate the average per location in grams. The total dust collected is shown together with the average for the seventy-one tests. The high-tension machine collected in the entire series 58.66 per cent. more than the Palmer, i. e., the latter col-

lected under the same conditions but 63.0 per cent. of the amounts precipitated by high tension.

Table III shows for a series of experimental charges an average return of 96.1 per cent. The dust content of the room used was, for the small amount of air passed, a negligible quantity. A larger series, with careful application, control of air currents, and variable amounts of different materials may yield a higher figure (see Second Series). The tables suggest that a certain percentage of material is lost, which percentage is, within limits, a relatively constant figure whether small (50 mg.) or larger (100 and 200 mg.) charges be used.

The findings in Table V may be summarized as follows:

Total H particles per cu. ft., 71 tests....	7,446,996
Average, 71 tests....................	104,887
Total P particles per cu. ft., 71 tests....	4,461,334
Average, 71 tests....................	62,835
H = % P..........................	166.9 %
P = % H..........................	59.9 %

In many Palmer dust samples, agglomerates were encountered, very evidently made up of smaller particles. These were counted according to mass, otherwise the number of particles undoubtedly would have been larger. The high-tension suspensions invariably presented an evenly distributed, uniform appearance.

In Table VI the high-tension figures summarize as follows:

Total tube weight increase...........	4.7824 gm.
Average, 71 tests....................	.0673 gm.
Total sample weights................	3.7395 gm.
Average, 64 tests....................	.0584 gm.
Total sediment weights..............	4.0998 gm.
Average, 71 tests....................	.0577 gm.
Average sample weight = % average tube weight......................	86.7 %
Average sediment weight = % average sample weight....................	98.8 %
Average sediment weight = % average tube weight......................	85.7 %

As a result of experiments in Table III, 96.1 per cent. of artificial dust charges were retained. If in the subsequent processing the dried total sediment represents 85.7 per cent. of the dust caught on the precipitator, and we assume the efficiency of the high-tension machine, based on Table III, to be 96.1 per cent., then the total sediment obtained by evaporation, on the basis of this comparison, represents 82.3 per cent. of the dust in the original air sample.

In Table VII the total weight in milligrams per cubic foot of air summarizes as follows:

Total Weights		Average, 71 Tests	H = % P	P = % H
HS	7.6959	.1069	S: 157.9	S: 63.3
PS	4.8134	.0677		
HO	2.7064	.0381		
PO	1.8095	.0254	O: 150.0	O: 66.6
HI	5.3875	.0758		
PI	2.9818	.0419	I: 177.3	I: 55.2

On the basis of the comparisons here reported, the Palmer figures in terms of high-tension returns are as follows:

	Table V	Table VII			Table VIII	Average
	Counts	S	O	I		
P = %H	59.9 %	63.3 %	66.6 %	55.2 %	63.0 %	61.6 %

The high-tension figures in terms of Palmer returns are as follows:

	Table V	Table VII			Table VIII	Average
	Counts	S	O	I		
H = %P	166.9	157.9	150.0	177.3	158.6	162.1

Applying the same criterion to the Palmer sediment values, if the Palmer shows a relative efficiency of 61.6 per cent. as compared with the high-tension machine, then we are justified in assuming that Palmer sediment values, as recovered in the crucible, represent but $61.6 \times 82.8 = 50.69$ per cent., or a little over half the actual dust present in the air sampled.

It is realized that the experiments reported are few in number (71), and that a much larger series may yield widely different average figures.

In using the Palmer apparatus there is always an indeterminable amount of dust which may fall into the bulb, yielding data which cannot be consistently compared with the amount which might enter the human breathing passages with their ascending nares. (Compare tests 10 and 11, Table VI.)

The type of high-tension machine used is far too bulky for ordinary field work, and until simplified, the Palmer represents the best method of dust collection for its purpose that we now have (8, 38). The higher values obtained with electrical precipita-

tion, together with the absence of certain objections to the Palmer method, leads to the belief that the former warrants further study.

Moreover, with increasing industrial installations for by-product recovery, it is conceivable that a simplified form of apparatus may be advantageously developed to run on the larger installations, by which the sanitary quality of the air may be studied throughout the plant.

For field work, a simplified apparatus has suggested itself to the writer and would include a small motor generator, such as used for electro-therapeutic purposes, which would furnish alternating current and at the same time run a standardized centrifugal fan. The transformer could be of the closed core type having the proper winding ratio, and could be air-cooled from the fan exhaust. A kenotron could be used to take the place of the mechanical rectifier (20), and the whole apparatus including a light aluminum collector and conveyor duct be made thus portable and practical (40).

The electrical precipitation apparatus, as used in this study, is far too bulky for ordinary field work, but can easily be simplified and made portable.

The method of electrical precipitation has certain advantages over the Palmer, viz.:

(a) Absence of suspending medium.
(b) Uninterrupted passage of air.
(c) Facility of determining the percentage of dust present in the air in the sample studied, and the percentage of air dust represented by the weight of total sediment.

These conclusions seem to warrant further study of electrical precipitation of dust as applied to the sanitary analysis of air.

TABLE VIII. — SUMMARY OF FOURTH SERIES BY DEPARTMENTS

Department	No. of Tests	Total HS 240 gm.	Total PS 240 gm.	Difference	H = % P	P = % H	Average per Location H 240	Average per Location P 240	Average per Location Difference
1	2	3	4	5	6	7	8	9	10
Talcum	7	.2567	.1813	.0754	141.58	70.62	.0366	.0259	.0107
Daniels planer	2	.1333	.1708	.0375	78.04	128.13	.0666	.0854	.0188
Cutting machines	3	.2273	.1118	.1155	203.3	49.18	.0757	.0372	.0385
Rag house	9	.2405	.1144	.1261	110.22	47.56	.0267	.0127	.014
Carpenter shop	10	.1938	.1249	.0689	155 16	64.44	.0193	.0124	.0069
Foundry	7	.2595	.1595	.1	162.69	61.46	.037	.0227	.0143
Grinding	8	.0577	.0361	.0216	159.83	62.56	.0072	.0045	.0027
Compounding	8	.1201	.0669	.0532	179.52	55.7	.015	.0083	.0067
Mixing	8	.1708	.0854	.0854	200	50	.0213	.0106	.0106
Compounding	9	.0977	.0565	.0412	172.92	57.88	.0108	.0062	.0046
Total	71	1.7574	1.1076	.6498					
Average		.0247	.0154	.0091	158.66	63			

Conclusions

The electrical precipitation method of dust collection in this series showed 62.1 per cent. greater average returns than the Palmer water spray sampler, for the same amount of air and under identical conditions.

The Palmer suspensions can give factitious counts because of agglomeration of particles in aqueous suspension. For this reason the actual number of particles present may be higher than those reported.

The writer wishes to express his indebtedness to Professor M. J. Rosenau, of the Department of Preventive Medicine and Hygiene, Harvard Medical School, for his many suggestions and kindly criticisms. Thanks are due Miss Lila M. Spence who made the chemical determinations here reported.

To the many officials and employees of the corporation which made possible the field work — men whose names are not mentioned at their own request — the writer is particularly indebted for their splendid spirit of co-operation, shown often with much personal inconvenience to themselves. Without their assistance the field work here reported could not have been done.

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APPLICATIONS OF PSYCHIATRY TO INDUSTRIAL HYGIENE *

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WE are nowadays being constantly reminded that we stand on the threshold of a reconstruction period. Warnings and advice emanate from varied sources — statesmen, financiers, industrial leaders and unemployed workers. A glance at the daily papers shows us that social unrest and industrial discontent are problems of immediate importance. A study of the more technical literature in the fields of political economy, education, industrial management, psychology, medicine, and social service, shows that a great many people are thinking, and thinking intelligently, about these problems. The hopeful aspect of the situation is that, whether the point of view is that of the industrial manager trying to reduce labor turnover or that of the physiologist investigating fatigue, there is shown a feeling of broad humanitarianism, a desire to understand each member of the industrial system as an individual, and a reaction against the old system of exploiting labor to produce wealth.

It is in just this field of understanding, the individual worker and his reaction, that psychiatry is of use. Carleton Parker (1) even goes so far as to say that: "Modern labor unrest has a basis more psychopathological than psychological, and it seems accurate to describe modern industrialism as mentally insanitary." Some causes of this mentally insanitary condition are brought out by Marot (2) in a book entitled *Creative Impulse in Industry*. Modern business enterprise and machine technology are said to have extinguished the joy of the creative experience; craftmanship is a thing of the past; an article owes its existence to an infinite number of persons, and a worker's claim to the product of his labor is merged in an infinity of claims which totally impersonalizes the industry. The worker has become a mere factory attachment, and surrenders himself to the rhythm of the machine. Thus creative desire has been lost and the only reason left for laboring is the predatory desire to possess wealth — to get paid off and to do as little work as possible for as large a reward as possible. But this is only one of many difficulties. Among the economists, Parker has been the pioneer and has most vigorously preached the necessity of understanding human behavior, and especially industrial behavior, from an individual standpoint. In his paper, *Motives in Economic Life* (1) he says: "We economists speculate little on human motives. We are not curious about the great basis of fact which dynamic and behavioristic psychology has gathered to illustrate the instinct stimulus to human activity. Most of us are not interested to think of what a psychologically full or satisfying life is. . . . Our economic literature shows that we are but rarely curious to know whether industrialism is suited to man's inherited nature, or what man in turn will do to our rules of economic conduct in case these rules are repressive." When human motives are isolated, described, and compared, such phenomena as business confidence, the release of work energy, the decay of workmanship, decline in the thrift habit, and labor unrest may be analyzed with some intelligence. But the careless *a priori* deductions touching human nature which still dominate our orthodox texts must be discarded. As a substitute for the orthodox and vague concept of human nature Parker gives a list of "some sixteen instinct unit characters which are present under the laborer's blouse and insistently demand the same gratification that is, with painful care, planned for the college student."

In his analysis of the I. W. W. Parker (3) shows that thwarting these instincts and condemning the worker to a life of limited happiness, restricted personal development, and desolation when sick, brings about a state of mind which amounts to an industrial psychosis. He says the I. W. W. is purely a symptom, and can be "profitably viewed only as a psychological by-product of the neglected children of industrial America." In other words we

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must treat these "mentally insanitary" conditions not only by shortening hours and increasing pay, but by so educating the children that they will be able to use their time off in ways that give constructive satisfaction to the instinctive cravings we all have for gregariousness, productiveness, motherliness, exercise of initiative, acquisition, ostentation, etc.

Other economists are taking up a similar point of view: Taussig (4) has shown that the pay envelope is not a satisfactory motive for work — other satisfactions are equally or more important. Irving Fisher (5) looks forward to the day when we will have a truer understanding of the nature of human freedom, saying: "What we liberty lovers are really groping for is, apparently, not to do as we think we please, but to do what will actually please us after it is done; that is, to satisfy fairly well all of the great fundamental human instincts, of which there are many besides the instinct of self-preservation or of making a living. The workman not only longs for more pay, but he hungers and thirsts for other things which he cannot formulate, because so largely unconscious." Tead (6) sounds the same note in his discussion of labor unrest, saying that a considerable part of it is really pathological and "might be called a definite industrial psychosis." Veblen, Wolf and others are writing in a similar strain. So it appears that the economists are becoming psychiatrists and are showing the way to the physician. If the physician is to take his rightful place in developing the mental hygiene of industry he must forget orthodox psychiatry (as the economist seems to be forgetting cut and dried political economy) and interest himself in a dynamic, individual psychology which recognizes the essentials of human nature and at last begins to analyze for us the elements of which human nature really consists, looking on each case as a human experiment in reaction to environment.

Sarah Murphy, aged 43, Catholic, a fur sewer in a department store in Boston, comes into the out-patient department of the Massachusetts General Hospital complaining of pain and numbness of her right hand. She goes to the medical, neurological, and industrial clinics, and after several visits acquires the diagnosis of "Occupational Neurosis." The social service department then takes her in hand, and finds out that the numbness of her hand began at about the time her oldest son went to France. Just previous to his departure he had married a Protestant girl, and because of his mother's antagonism to the match, the ceremony had been secretly performed in a Protestant church and the mother had not been informed until afterwards. The patient was in the habit of getting breakfast and supper for her other two sons whom she was educating in technical schools. Beside this she worked all day at the store. On Sundays she was too tired to do anything, but dragged herself to church as a duty. It was found possible to send her away for a two weeks' rest, a scholarship was procured for one son, and a job for the other whereby he was enabled to pay for his own tuition. With this relief, and a superficial explanation that her trouble was due to work and worry, a cure was brought about.

Anyone interested in the psychogenesis of mental breakdowns can easily see the mechanism: the emotional shock of the older son's marriage taking the joy out of the mother's life; the feeling of self-pity arising from her long hours of work, the feeling that the situation was intolerable, and the inability to face this situation, all finally tended to bring about the hysterical escape through the development of her symptoms. This is exactly the mechanism we have become so familiar with in the war neuroses. And if the department store physician had been interested in psychiatric problems, a half hour's interview, a visit or two of the nurse to the home, and the cure would have been brought about expeditiously without recourse to the necessarily slow and cumbersome diagnostic machine of a great hospital; and both the store and the patient would have been saved some weeks of work. Such cases can be found everywhere, our wards and dispensaries are full of patients to whom the doctors apply long meaningless labels — "neurasthenia," "psychasthenia," "psychoneurosis" — and for whom they do little. By an investigation of the patient's personal problems, an understanding of the usual reactions of the human being, and by simple help in readjusting the patient to the environment, a great deal can be done.

It is not only the cases of illness that should be attacked in this way. Many people with similar unbearable situations do not develop the usual symptoms that we

recognize as illness. They merely become inefficient, restless, wander away from their jobs, or become radicals and bolshevists (7). Peabody (8) and his collaborators found an interesting example of this in the cases of Effort Syndrome studied at U. S. A. General Hospital No. 9. A striking number of the histories showed that in civil life these men drifted from one employment to another, never breaking down enough to consult a physician, but adding their number to the shifting, inefficient labor element so costly to employers. It took the rigor of army life, with no possibility of escape by moving on, to bring out their symptoms. Before these people have left their work or have been fired for inefficiency, they should be interviewed by someone competent to understand them and their probable troubles. At such times advice from a physician, the loan of some money, a visit to a sick child or wife, or any of the thousand possible personal and individual aids, might save the worker from becoming soured, keep him from joining the ranks of the discontented, and prevent the development of a litigant and paranoid personality. Employment managers are beginning to recognize these facts and are using various methods to alleviate the troubles: one firm employs a lawyer especially to watch the loan sharks and help out employees in financial difficulty. Others keep man-record charts (9) and watch carefully the workers' efficiency. Too often this is merely for purposes of sizing up the employee, but one firm has shown that frequently a drop in a man's efficiency can be traced to personal difficulties of a nature that can be helped.

So we get back to the necessity of understanding human nature and of giving to the fundamental human cravings an outlet. The instinct of self-preservation is partially satisfied with the pay envelope; welfare work helps to make possible satisfaction of the instinct of home-building; but with our present industrial system it is harder to see how the cravings for self-assertion, creation, excitement, and the like can be met. The atmosphere created by the division of labor and scientific management is repressive to all these instincts — the man may develop a feeling of inferiority, and unless given some outlet he will become discontented and get satisfaction through striking, drinking or other abnormal sublimation. These are mental problems and must be so looked upon by physicians interested in mental hygiene, but the whole problem is so complex that at present most industrial physicians will consider it more expedient to watch for the psychotic symptoms to appear in individuals and then do their best to treat them sympathetically in the light of their knowledge of industrial psychology.

The recent work done in the personnel department of the army has awakened wide interest in the possibility of applying mental tests to applicants for industrial positions. The ultimate aim is to fit the job to the man so well that discontent will be minimized and labor turnover reduced. Ball (10) advocates the establishment of laboratories for the thorough medical and psychological examination of all employees; he believes that in this way men can be fitted immediately to the right occupation, without the costly experiment of trial. Although his paper reads well, it is not convincing and the methods advocated seem generally impracticable. In the army work, however, the psychologists certainly showed that they could pick out the capable men by comparatively short group tests, and Ball gives outlines of similar tests. In a more restricted way mental tests have been applied in industry for some years. Jaques (11) had excellent results in choosing typists and stenographers for certain types of work by psychological tests, and the results of these tests correlated well with the output later shown by these employees. Lamb (12) also reports success in gaining better judgment for selection and placement of employees by intelligence tests. On the other hand, Kelly (13) exposes some fallacies of the army rating system, especially in its application to industry. Strictly speaking, these tests have psychiatric interest only when used for the detection of subnormal individuals, but they seem to be of value from the prophylactic standpoint in reducing misfits in the shops — and maladaptation to environment is the basis for many mental breakdowns. In the present state of our knowledge perhaps Johnson's (14) suggestion is the best: he recommends that factory training departments be installed in all plants as testing places for applicants for factory work. And he claims that by thus eliminating incompetent and unqualified candidates the morale

of the departments is kept at a higher level and labor turnover is decreased.

Fatigue is another subject that comes into the field of industrial psychiatry. A great deal of work has been done by physiologists on neuro-muscular fatigue, and by the psychologists on mental fatigue. Spaeth (15) has recently reviewed the whole subject thoroughly and brought the two points of view together. Though a biological physiologist, he has given the psychological element in fatigue its just due. He states that laboratory subjects and industrial subjects are absolutely incomparable units. He uses the term " industrial fatigue " for the daily and weekly weariness resulting from industrial work, and suggests the term " industrial psychoneurosis " for the " gradually accumulating fatigue of the over-driven industrial worker." Overwork, however, is not the fundamental cause of neurosis or psychoneurosis. These disorders are fundamentally emotional breakdowns due to lack of satisfaction with life, so the theory that the etiology is " gradually accumulating fatigue " is untenable. The symptoms may simulate fatigue, but neuro-muscular fatigue is cured by simple rest, and these conditions are not. " Industrial psychoneuroses " are simply neuroses with an occupational coloring due to the work in which the individual happens to be engaged.

The mechanism of such a neurosis is typically something like this: An individual is in an intolerable situation which he is constitutionally unable to dominate; the reaction of a neurosis sets in with depression of spirits, irritability, preoccupation, self-pity, etc., but a conventional cause for the decreased efficiency must be found to rationalize the situation, so the individual calls it overwork. Obviously with this idea of overwork in mind the symptom usually acquired is fatigue or asthenia, but frequently symptoms more closely associated with the work are developed, such as paralysis of parts of the body necessary for work, muscular pains making work impossible, tremors, or even epileptiform seizures. The case quoted above is an example of emotional breakdown from personal causes taking on an occupational symptomatology. The work may have determined the form of the symptoms but there is no evidence that it had much to do with the development of the trouble. Work may of course be an etiological factor, but not through so simple a mechanism as accumulated fatigue. Work that represses emotional cravings often brings out neuroses, just as satisfactory work is the greatest curative agent we have for these conditions. Let us no longer fool ourselves into thinking that overwork, *per se*, is the cause of mental breakdown.

To sum up, the problems of industrial psychiatry are:

A. Prophylaxis of mental breakdowns by adapting the worker to his environments, and eliminating causes of discontent.

B. Treating psychiatric cases when they arise in a rational way according to the facts of each case, and considering as psychiatric phenomena many forms of behavior that until recently have been given unsympathetic names, e. g., " the groucher," " the kicker," " the trouble maker," and " the hobo."

As conditions are at present, a reasonable application of psychiatry to industry would seem to be the following:

1. Physical examination of all applicants for work.

2. Mental examination by (a) a period of training and observation, or (b) through mental tests.

3. Keeping in personal touch with employees' individual problems by means of (a) good foremen, (b) a system for watching individual efficiency, or (c) a sympathetic staff with a psychiatric point of view in the employment management office, thus salvaging the men who might otherwise be fired.

4. Training the industrial physician to a knowledge of how human nature is constituted, not in conventional terms, but in the light of a dynamic and living psychology that considers the behavior of human beings in terms of instinctive sources of energy, integrated into motives, these motives needing outlet through energy transformation into *satisfactory* activity.

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FLATFOOT AND ITS PREVENTION*

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WHILE everyone admits the importance of strong feet, no systematic efforts have ever been made to correct the common and weakening disability popularly known by the general term flatfoot. The subject is, however, well worthy of the attention of public health officials and of employers of labor as well as of the public itself.

In Europe the problem of flatfoot has been considered by army surgeons, and its correction and prevention have long been a matter of gymnastic drill and shoeing; but in this country before the war flatfoot was a subject relegated to the consideration of a few specialists. Now that the war has shown the extent of foot weakness among Americans, the importance of the question cannot be denied. Indeed, it has been suspected for a long time by experts that the American people were becoming the most weak-footed people in the world. As recent figures seem to justify the suspicion, means should be taken to check this increasing and by no means despicable evil.

The importance of the subject is well recognized in the equipment of armies, and governments devote much care to the footwear of their soldiers. Little or no attention, however, is paid by the directors of factories, large department stores or railroads to the condition of the feet of their employees. And yet the standing capacity of workers is an important factor in efficiency, and fatigue is of importance in civil no less than in army life. The test of leg fatigue in war is more sharp than in the work of a clerk or a shop girl, but tired feet are tired feet, and detract from the serviceableness of either shop girl or soldier.

What the normal static foot strength should be in any individual is a matter of estimate based upon judgments formed from examination of an adequate number of cases, normal and abnormal, and no precise statement can be made defining the normal. It can, however, be assumed that individuals of average health should be able, with proper care of their feet, to engage in any ordinary occupation without foot distress. If they are unable to do so, the cause of their weakness should be determined, and in a large majority of cases it will be found to be due to improper footwear, either at their work or in the period before their work was undertaken. In this statement the small group of congenitally or paralytically deformed feet is not included, but attention is called to the large group of individuals who unwittingly injure their foot strength and cause themselves unnecessary discomfort.

The remedy for this widespread difficulty is to be sought by calling the facts to the attention of the shoe-wearing and shoe-purchasing public and to those whose business it is to shape, furnish and sell shoes. There is no doubt that the shoes commonly worn are the chief cause of foot weakness. Formerly shoes were made by cobblers and small manufacturers, and varieties in shape according to individual needs were possible. At present, however, shoes are made in large numbers under the direction of comparatively few people and the needs of the individual cannot be considered. The foot is shaped to the shoe more than the shoe to the foot. The excellence in appearance of footwear and its universal purchasability have made Americans not only a shoe-wearing people, but a factory-made shoe-wearing people. Undoubtedly barefooted people are stronger footed, but Americans will never become a barefooted people.

A number of Chicago citizens who volunteered for enlistment at the outbreak of the Spanish-American War were photographed naked and the picture was published in a medical journal by the examining surgeon as showing fine types of American manhood. The picture in question displays a remarkable collection of healthy and well-proportioned men, all standing in a markedly weak-footed, knock-ankled and splay-footed position. Their condition would have practically incapacitated them for efficient marching. If, in comparison with this, any photograph of a standing group of naked South Sea Islanders or Africans be examined, the contrast in evident foot strength of the

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otherwise physically inferior barefooted savages is striking and noteworthy. Moreover, it appears to be true that there has been no improvement in American foot conditions since the Spanish War.

The result of the physical examination of the first million draft recruits (Jour. Amer. Med. Assoc., 1919, 73, 272) showed,

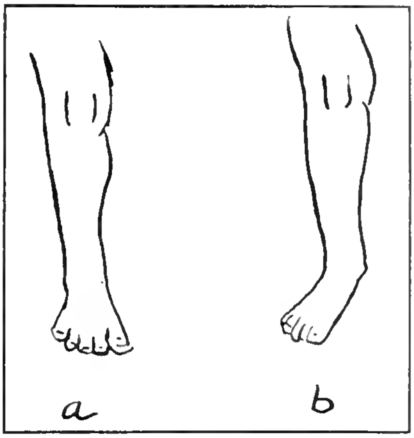

FIG. 1.—(a) Strong static position; weight falling over middle line of bony structure of foot. (b) Weaker static position; weight falls inside mid-foot line, causing strain on inner ligaments.

among other interesting facts, "the overwhelming predominance of flatfoot as a physical defect. The condition was found in the ratio of 177.45 per 1000, or nearly eight times as many as any other defect." . . . "The comparison between men coming from rural districts is also interesting. The amount of flatfoot from the Southern states is markedly less than that from the Northern states. Probably the mildness of the climate and the general practice of negroes and boys — especially among the rural classes — of going barefoot is responsible for the better development of the feet, and consequently for the smaller percentage of flatfoot in the South."

In static flatfoot (plano valgus) — a deformity characterized by the falling in and down of the ankle and the middle of the foot — the front mid-line of the foot points outward instead of following the mid-line of the leg, and the weight-bearing strength of the foot is lessened as the body weight comes unduly on certain non-weight-bearing structures. There is no question that this deformity is the result of footwear, and the need of reform in shaping shoes is clear.

The reduction of the strength of nearly eighteen men in every hundred is a heavy tax to pay for a lack of wisdom in shaping and buying shoes. Furthermore, there are other shoe deformities than flatfoot, *viz.*, distortion of the toes, weakening of the toe grip upon the ground, and the spread of the front of the foot, all of which, while causing little trouble ordinarily for light workers, are handicaps for heavy laborers or for persons who have to stand for long hours.

An examination of American shoe lasts shows a common disregard of the evident fact that the inner side of the front of the foot is much higher along its whole line than the outer side, when the foot is placed in the strong weight-bearing position. Shoes made from lasts which are flat in front exert pressure on the inner side of the front foot, forcing it down to a lower level. To reach this lower level, the front of the foot is turned out, twisting at the mid-ankle cross joint, and the inner arch is pulled in and down. A knock-ankled, splay-footed, and weaker static position is unconsciously taken, which, in turn, under fostering conditions may produce a crippling plano valgus, i. e., a painful and stiffened flatfoot.

The American last is often not only too flattened in front, i. e., back of the ball of the foot, but also is even concaved down. In shoes made from such lasts, free action of the toes and the toe grip — important in heavy weight-bearing or in fast walking — are seriously hampered and, indeed, in anything but an over-loose shoe, are made practically impossible. This is not obviated by making the sole of the shoe wide, because the leather of the shoe stitched firmly to the stiff sole acts as a band, tying the toes down flat. Flattening the last in front also produces a shoe which presses upon the distal ends of the metatarsals. When the foot slips forward in the shoe in walking, this produces a strain upon the middle of the front of the foot which it was never shaped to bear, humps the middle of

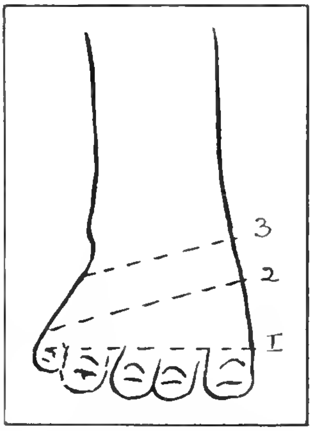

FIG. 2.—Diagram of foot in strong position, showing the inner edge of the foot higher than the outer.

the foot up and presses the heads of the metatarsals down. This causes a strain upon the plantar muscles and causes contraction of the toes, giving rise in extreme cases to the so-called claw foot.

These defects in the shape of lasts, although important, have received much less attention than they deserve, and it is for this reason that they are referred to in this article in preference to other defects already noted by medical writers. A disregard of the above-mentioned facts impaired the usefulness of the army shoe in the last war. Owing to the fact that the army shoes were too greatly flattened at the front to be serviceable, it was necessary to supply unduly long and loose shoes. Where this was not done foot strain was apt to follow. A Red Cross nurse who returned from service at the front reported that the soldiers in her hospital complained more of their feet than of their wounds.

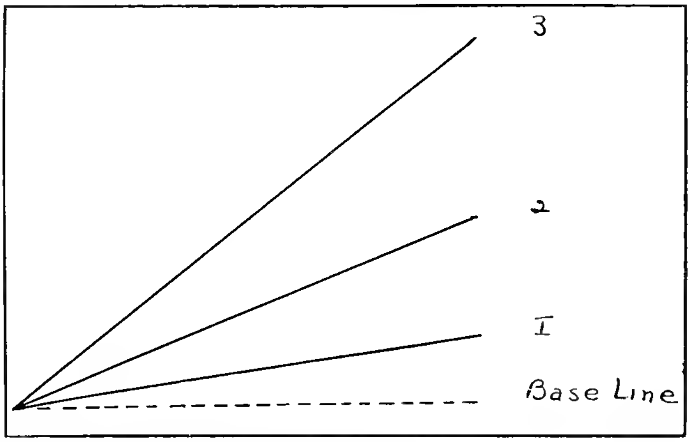

Fig. 3. — Lines drawn across the front of a normal foot, not injured by shoes, placed in a strong weight-bearing position.
1. Across the line of the toes.
2. One inch back across the line of the toes.
3. Two inches back across the line of the toes.

A reformer in the matter of footwear is at once confronted by the statement that shoes are made to sell and that as long as improperly shaped shoes are the only ones salable, manufacturers can only make such shoes. The argument would be forcible if it were true. At present the working public is, so far as its footwear is concerned, at the mercy of manufacturers of shoe lasts. There is a definite need of shapely, non-injurious shoes for working people, and the exercise of properly directed business energy in this direction would find ample financial return. There is no doubt that to a large class of individuals who need foot strength but little, footwear is a matter of costume, and the style of a shoe is what sells it. This desire for appearance need not be neglected, but anyone familiar with former shoe fashions can satisfy himself that styles can be manufactured which would become fashionable and at the same time be less injurious than those now forced upon the American public.

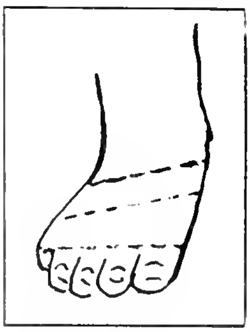

Fig. 4. — Weak weight-bearing position.

The prevention of the widespread foot disability and static weakness in our communities caused by shoes, is not as difficult a task as might at first be supposed. It is first necessary that the shoe-purchasing community should be made aware of the fact that ill-designed footwear cripples the feet. Individuals must be taught to distinguish between the footwear which can be safely worn in leisure hours and the footwear which is needed when they are at work and must economize their foot strength. That this fact is recognized in the army is shown in the difference between army and civilian shoes. Tennis, gymnasium, baseball, and nurses' shoes are all products of a need for suitable work shoes. At one time the shoe market was flooded with cramping styles of infants' and children's shoes. A few energetic manufacturers had the good sense to turn out more sensible styles with the advertising caption, "Every toe a helper." This resulted in the gradual improvement of children's footwear.

There is also among shoe manufacturers an earnest effort to produce so-called hygienic and orthopedic shoes. Further attempts in this direction, guided by somewhat more accurate anatomical and physiological knowledge of the needs of the foot, could easily produce shoes which would be much less injurious and at the same time not unsightly. The nurse's shoe can easily be made as well adapted to its service as the baseball or football player's shoe, and yet retain its saleable quality.

There is no reason why the large employers of labor should not pay as much attention to the subject of proper foot-

wear as is done by the quartermaster's department of an army, and there is little doubt that shoe manufacturers would readily fill any orders which might be presented in this way. If working shoes were made in sufficiently presentable styles, they would undoubtedly be gradually adopted, especially if they were sensibly recommended by industrial physicians, many of whom are employed in an advisory capacity in industries demanding foot strength of their employees. Advisory physicians should not, however, content themselves with advocating sensible shoes and preventive measures for checking the development of foot disabilities. They should inform themselves as to the best practical methods of relieving existing foot weakness and of instructing working people how to strengthen or how properly to utilize their remaining foot strength. It does not, however, fall within the scope of this article to describe the surgical methods which specialists can make use of in the correction of various severe static foot distortions or grave shoe-caused deformities. The advisory surgeon may well inform himself of these and can easily acquire familiarity with such surgical procedure. A little experience will enable him to judge the various grades of the more common static disabilities, and to apply suitable means of relief.

A physician can form his judgment as to foot defects, not only by watching the gait of the individual examined and the standing and sitting positions of the foot in its habitual relation to the line of the whole limb, but also by observing the footprint of an individual whose bare foot has been dusted with talcum powder and who is then made to walk about on a wood or a linoleum floor. A plaster of Paris cast is unnecessary and may be misleading since it gives only the contour of the foot at rest and not in action. The flexibility of the joints of the feet should be examined and any stiffness noted in the plantar flexion at the metatarsal joints of the toes. It should be noted also whether the ball of the great toe does its share of weight-bearing as indicated by the callosities of the sole, and whether the great toe joint has not been forced up to a higher level than the corresponding joints of the middle toes, causing a flattening of the front cross arch of the foot. The spreading power of the front of the foot should also be examined when weight falls upon it, and when the heel is raised as in walking up and down stairs. The side flexibility at the cross joint of the ankle (the astragalo-scaphoid and calcaneo-cuboid articulation) should be determined, especially to the inner side, as any abnormal stiffness in this direction marks a tendency toward the development of static flatfoot (plano valgus). This can be detected by holding the leg firmly near the ankle with one hand, while the other hand grasps the front of the foot and moves it sideways. A loose heel bone (os calcis), resulting from undue weakening of the calcaneo-astragaloid ligament, can be determined by an attempt at sidewise movement of the heel bone.

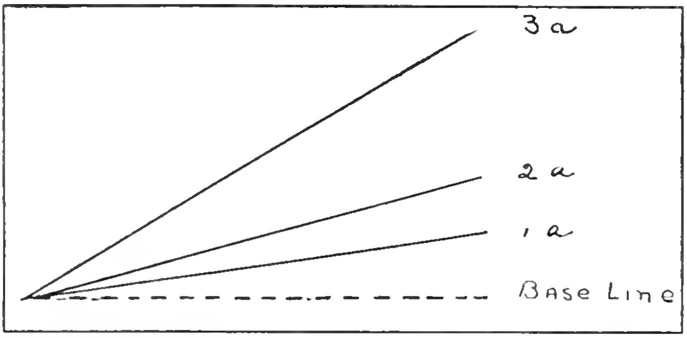

Fig. 5. — Lines drawn across the front of the foot in a weak weight-bearing position.
1a. Across the toes.
2a. One inch back of the line of the toes.
3a. Two inches back of the line of the toes.
This figure indicates the amount of the dropping of the arch and the lowering of the inner side of the foot when the foot is held in a weak weight-bearing position.

When a patient is standing on one foot, the mid-line of the weight-bearing foot should be noted in its relation to the mid-line of the whole limb. This line does not normally fall to the inner side of the weight-bearing foot; there should not be an undue prominence of the ankle bone to the inner side; nor should the heel bone of the foot as seen from behind appear to slide to the outer side of the mid-line of the leg. The side contour of the foot should be noted particularly. In flatfoot there may be also a prominence of the bone in the middle of the foot with the toes drawn up in a claw-like position. Looking down upon the foot the toes should not be crowded, but should be flat and straight,

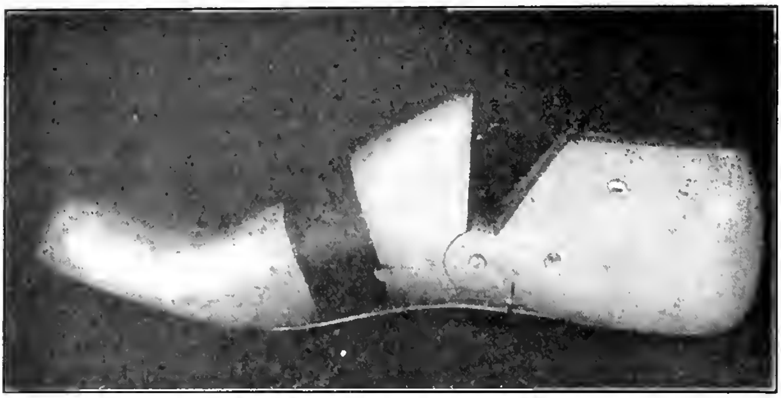

Fig. 6. — Photograph of last of improved army shoe, showing undue flattening of the last on the front of the foot.

following the mid-line of the foot. An exception to this may be made of the little toe which is always curled in shoe-wearing people — a slight deformity. There should not be a depression at the base of the middle toes. The front of the foot should be well rounded up, but the inner side, from the great toe up to the ankle, should be much higher than the outer side. The sole of the foot should be well muscled. A thin and apparently high-arched foot is often an indication of plantar muscles weakened by improper shoes or prolonged wearing of arch supporters.

Stiffness of the joint at the ball of the great toe, projections, and redness in this region — the result of shoe friction or of pressure of shoes too flat on the inner side — are of importance, as well as the common outward deviation of the great toe. This latter, so usual in individuals who wear pointed-toe shoes, is of less importance as a disability for standing or for slow walking than for persons needing active front foot walking. This is also true of other toe distortions, unless heavy lifting or long standing is demanded.

Much can be learned, from an examination of the shape and sole-wear of worn shoes, concerning the strain of the foot upon ill-adapted footwear, but one must remember that there is an individuality in gait not easily recognized by the individual himself or by the observer, and that people often vary in the work they put upon the different feet, being right or left-footed. X-ray pictures of both the bare and the shod foot are serviceable in determining how the foot lies in the shoe.

The examiner will be able readily to make the observations necessary for an estimate of the static foot ability of those examined. It is, moreover, of importance that such an estimate should be considered in connection with the subjective symptoms mentioned by the patient, i. e., pain and fatigue. A distorted foot may give but little pain and an apparently well-shaped foot may give much discomfort if improperly shod or overworked. If this is borne in mind, mistakes in judgment may be avoided. The question is not one of degree of deviation from the normal so much as it is whether or not the individual is able to stand up under his load. A number of instances have been observed in the recent draft examinations, where splay-foot track walkers and long-distance runners were rejected by conscientious examiners, though more capable of tramping than many accepted men. In many other instances, weak-footed soldiers were cured when properly shod.

After rejecting or assigning to sitting work those manifestly unable to endure long hours of foot strain, we have left a large class of people whose feet can be brought into excellent working condition if properly nursed. The treatment of foot

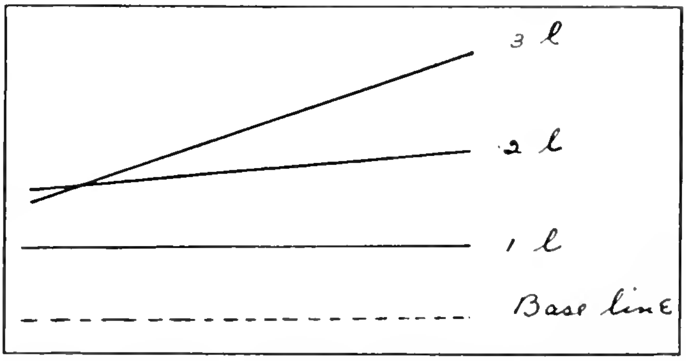

Fig. 7. — Lines drawn across the army last, showing flattening at the toe line and insufficient height on the inner side.

1l. Across the line of the toes.

2l. Just behind the line of the toes.

3l. Two inches back of the line of the toes.

This diagram indicates that the army last is not sufficiently high on the inner side.

strain differs in principle in no way from the treatment of strain elsewhere. There should be avoidance of the exciting causes of strain, proper rest and massage or other

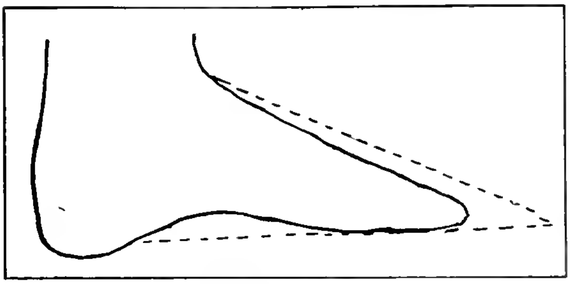

Fig. 8. — Diagram of side view of foot.

measures to stimulate impaired circulation, and, finally, use of the foot should be permitted to a gradually increasing degree.

Adhesive plaster strapping and bandaging, needed in the acuter stages of strains, are not suited to the chronic stages which demand measures to increase the circulation and to strengthen weakened tissue, and then gradually increasing use. Massage and graded exercises are of service, but it is of prime importance that the individual should recover the natural position in which the body weight falls properly upon the foot and not in such a way as to bring undue strain upon overworked ligaments. In a large number of cases, the recovery of the proper position is possible by barefoot walking on a sand beach or on turf, or by the free use of moccasins in leisure hours. The feet of every individual should be freed from shoe constriction and given, if only for a brief time each day, emancipated use. Even the constriction of the stocking, certainly that of the pointed slipper or shoe, limits the proper exercise of the plantar digital muscles and simple daily exercises, such as rolling heavy dumb-bells with the feet, attempting to grasp a towel with the feet, balancing the body on one foot upon the yielding surface of a mattress or cushion, or similar exercises, systematically and daily used, are effective in restoring foot power. Where stiffness of the joints, limiting the flexion and side movements of the front of the foot, is present, manipulations are needed to give proper static suppleness to the weight-bearing foot. Cases of fixed distortion, where more than ordinary measures are required, need not be condemned as incurable, but such cases demand the care of a specialist.

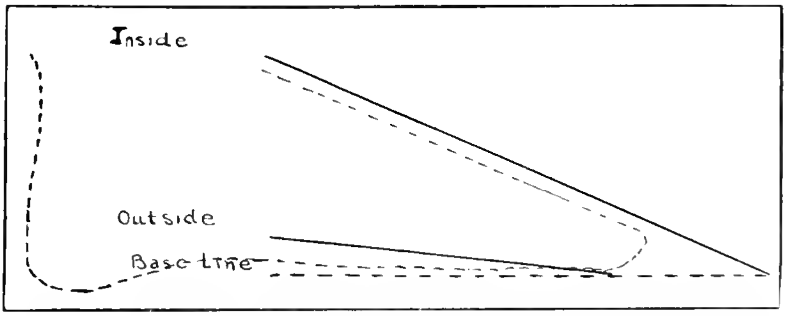

Fig. 9. — Diagram of lines laid over the outer and the inner side of the bones of the foot. Side view showing how much the inner edge is higher than the outer edge. Unless the shoe is shaped to meet this, it tends to throw the foot wrong.

Whatever treatment is needed, it is manifest that the foot, during working hours, should not be boxed in unyielding shoes or in shoes which make difficult or impossible the proper weight-bearing position of the foot or the free use of muscles needed for correct standing and walking. Improper shoeing causes the foot to suffer and diminishes the static power of the individual.

Reliance is often placed upon arch supporters to help relieve the strain of the superimposed body weight. The custom-made stiffened insoles sold by shoe dealers for this purpose are useless. When an X-ray picture is made of a shod foot with such a support under the sole, the plate will be seen not to be under the part of the foot which needs the maximum splinting. What is needed is not a support to hold up the arch of the foot and thus to prevent its flattening, but something which holds the foot from falling under the body weight too far to the inside of the mid-line. Plates constructed to do this effectively are heavy. Moreover, they do not serve their purpose except in the standing position with the weight falling directly upon them, and are not of use in other phases of gait. More than this, if continuously used they cause by their pressure, as do splints applied to the limb, weakening of the muscles, and are therefore eventually injurious.

Shoes shaped with the purpose of correcting deformed feet on so-called orthopedic lasts are necessarily ineffective if they are intended to force the foot into a normal position. In short, working people whose

foot muscles are so weakened that plates and special shoes are needed, require individual treatment. A support is a crutch and a crutch means a cripple. To put a supporting plate inside a muscle-cramping shoe is as irrational as to continue a poison while applying an antidote. Many individuals who have worn close-fitting muscle-binding shoes cannot suddenly change to muscle-developing shoes. The change must be gradual, with slowly increasing use of non-constricting shoes. The eventual use, however, of a suitable non-foot-binding shoe is necessary for foot strength and health.

There are four important facts, which are often overlooked, to be remembered in considering the working capacity of feet:

1. The spreading power of the toes and front of the foot.

2. The strength of the toe clutch upon the weight-bearing surface.

3. The greater height of the inner side of the foot, as compared to the outer side, from the ball of the great toe upward to the ankle, while the foot is in the habitual non-weight-bearing position.

4. The degree of the mid-ankle motion to the inner side.

Shoes made for and worn during working hours without regard to these facts hamper the functions of the foot and impair its normal service. It is evident that more is required than the statement of surgeons as to the need of improved lasts. The purchasing and manufacturing public must first be convinced of the desirability and possibility of improvement in the style of shoes, and then they must be informed as to ways in which this improvement can be accomplished.

A muscularly inferior man may walk to his work on a sidewalk without discomfort or knowledge that any of the muscles of his feet are checked in possible action. If, however, this same individual is forced to carry a heavy load over an uneven surface, he will not be able to stand up to his work as well as a stronger-footed person. If he wears, as do so many working people, footwear which checks toe spread and toe grip and throws his feet out of line, he becomes physically inferior to his more sensibly shod competitors. Much activity is possible with little use of the toes. The Chinese bind the feet of their women to limit their activities and yet the crippled women are quite active on their deformed feet. North American Indians cut off the toes of their captives that they might be

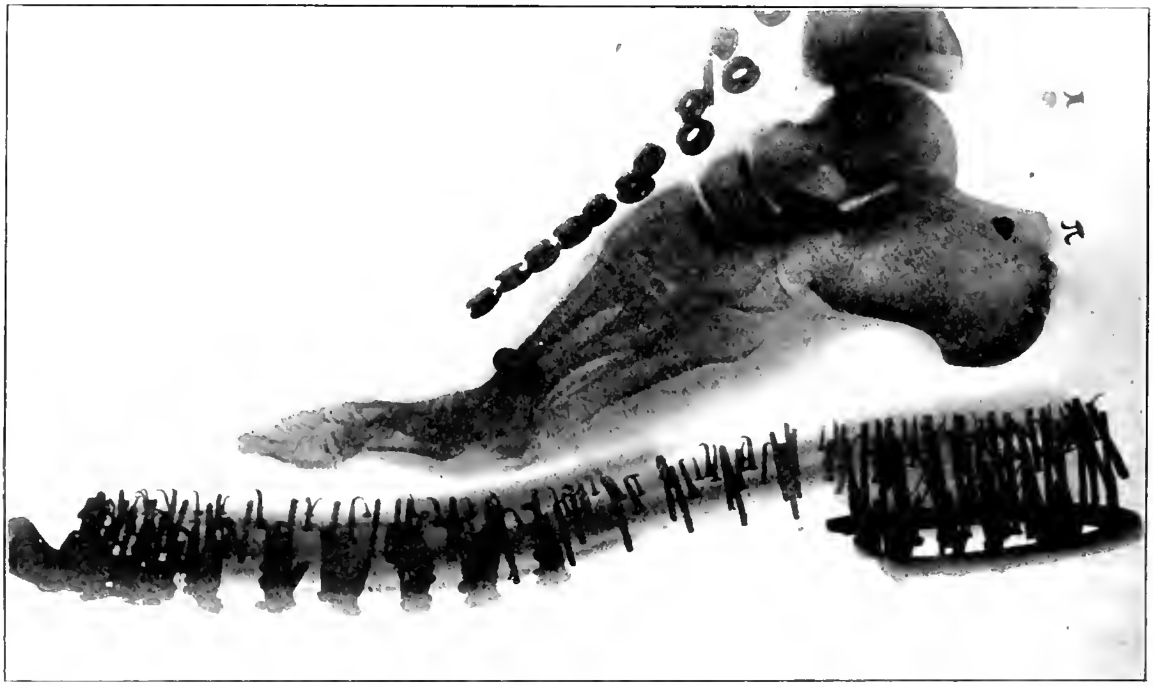

Fig. 10.—X-ray picture of the foot in the Pershing army shoe, indicating the effect of a shoe made on a last flat across the line of the toe joints, and the necessity of an unduly large shoe to enable the foot to slip into a shoe made from a last too flat on the inside.

able to do standing work but could not run away. The ordinary commercial American shoe checks the spread and play of the toes and front foot, and hampers the force and strength of the toe grip and push.

It has been a matter of national pride that Americans have achieved distinction in international track athletics, but the events in which they have excelled have required limb strength more than foot strength. Indeed, the records of Americans in Olympic and international Marathon runs requiring toe clutch and foot endurance for a long distance have been by no means as good as in other sports. In the recent games at the new Pershing Stadium in France the Americans were easily winners, but they were beaten in the Marathon and cross country run by two Frenchmen. The French claimed that the Americans had dash, but lacked endurance. Perhaps the lack of endurance is due to the use of faulty shoes.

Both the Turkish porter who can carry a piano on his back and the Japanese rickshaw man would outclass the American in foot strength. It may be argued that the American is not a hewer of wood and a drawer of water; that with machinery he can supplement the heavy work of serfs and peasants. This argument, however, can be disregarded inasmuch as heavy labor will always be needed. Certainly there is no reason why the American should be content to remain in any respect muscularly inferior when this can be, in part at least, prevented by removing an important cause of his foot weakness — i. e., ill-shaped footwear for working hours.

There is no doubt that the shoe last can be improved. It ought to be possible to bring the buying public, the dealers and the manufacturers to a common understanding. The American of fifty years ago was sensibly and well shod. The American of today is not wanting in intelligence. He does not want "freak" shoes, but how can his wife or the working woman easily purchase anything else? A condition of affairs in which 177.45 per 1000 of our recruits are rejected as incapable of heavy work, when a normal foot is hard to find in our city population, when even the shoes of our soldiers are faultily shaped — such a state of affairs is not one in which to rest content. We are waiting for a manufacturing Moses to lead us out of the land of foot thralldom, for a Saul among the retailers who will free the public from shoe bondage, or for a liberating Garrison who will arouse the public to demand emancipation from the tortured servitude of mistreated feet.

REPORT ON CERTAIN ORGANS IN A CASE OF FATAL POISONING BY ARSENIURETTED HYDROGEN GAS*

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[As there are very few (if any) accounts published of the microscopical appearances of the principal organs — the liver and kidneys — affected in poisoning by arseniuretted hydrogen gas, the following account of one such typical case by Professor Sheridan Delépine has interest. His report shows how different is the condition of the liver found from that of phosphorus poisoning or from that accompanying toxic jaundice, the result of poisoning from nitro-derivatives of benzene and its homologues.

The process upon which the deceased man, A. R., aged 45, was engaged was one for the extraction of metals from zinc chloride. The zinc, containing impurities, was dissolved in hydrochloric acid, this being added until the solution was neutralized. The mixture was then filtered in presses, the resulting liquor being subjected to the action of massive zinc by passing the liquor over bars of zinc. The resulting liquor was next treated with zinc dust to cause precipitation of certain of the metals, the zinc dust being first mixed with water to facilitate the action. The process was carried out in rather a confined shed in open vats.

A. R. was working on this plant and tipping the zinc dust into the liquor, when a more violent action than usual occurred with the result that the liquor "boiled over." He was at work from 2 P.M. till 10 P.M. On his way home he felt sick and vomited, could not eat any supper and during the night was sick and had pain in the stomach. He went to the doctor's surgery the next morning, complaining of gastro-intestinal diarrhea. The case was regarded as one of gastro-intestinal disturbance due to food, as such cases had been very common in the district for months. Two days later he was seen to be distinctly jaundiced but with general symptoms somewhat improved. He said he thought the "zinc" process in which he had been engaged had affected him, and, in the opinion of the chemist, arseniuretted hydrogen gas might have been evolved. A. R. was removed to the Victoria Infirmary, Manchester. He seemed to improve in the Infirmary, sickness, diarrhea, and pain ceasing, and he took nourishment freely. As no urine, however, had been passed in the Infirmary, a catheter was used, and 2 ounces of a brownish fluid drawn off showing that hemoglobinuria was present. Seven days after he left off work there was total suppression. He became gradually weaker, and vomited again; he passed into a drowsy condition and died on the eighth day. — *T. M. Legge.*]

ON June 21, 1917, I received from Dr. J. C. Bridge the liver, spleen, right kidney, stomach, part of the pancreas, part of the left ventricle of the heart, and some of the blood from the right auricle of A. R., *aet.* 45, who had been working in connection with a process of extraction of cadmium, lead and copper from zinc chloride, and whose death was suspected to have been due to the inhalation of arseniuretted hydrogen. The man died on the eighth day after exposure. A post-mortem examination was made on June 21, about forty-eight hours after death.

General Post-Mortem Appearances

From the post-mortem notes communicated to me by Dr. Bridge, the following particulars may be quoted briefly as having a bearing upon the investigation which I carried out subsequently in the laboratory.

The *heart* was soft and its walls appeared to be slightly fatty.

The *lungs* showed considerable hypostatic congestion.

The *liver* surface was smooth; the cut surface was pale and showed signs of a fatty change with possible fibrosis.

The *right kidney* weighed 8 ounces, was enlarged and dark on its external surface; the cut surface was pale and apparently fatty.

The *left kidney* weighed 9 ounces and had a similar appearance.

The *spleen* weighed $4\frac{1}{2}$ ounces and appeared darker than normal.

The *pancreas* weighed $4\frac{1}{2}$ ounces and was apparently normal.

The *brain* appeared normal.

The *bladder* contained about 1 ounce of decomposed dark urine. (There had been suppression of urine during the last two or three days.) †

The following additional notes were taken by me when I received the organs previously enumerated:

Liver. — Weight, 1757 gm. (3 lb., 14 oz.). Large, not very soft; capsule smooth; parenchyma generally pale, as if in a state of cloudy swelling or early fatty degeneration. Superficial part of the upper region of the right lobe, purplish in color; other parts of the parenchyma slightly bile stained; central parts of the organ and more particularly the tissues adjacent to the large vessels purplish-black in color as if stained by altered blood pigment. Gall bladder moderately filled with dark green bile.

* Received for publication July 30, 1919.

† Between November 14, 1918 and February 3, 1919, I examined the [illegible] of [illegible] men engaged at important dye works in carrying out [illegible] requiring the use of hydrochloric acid and zinc dust. I [illegible] arsenic in the urine of four of these men. The amount of arsenic [illegible] material in the three other men, who were [illegible] at the time from [illegible] and methemoglobinuria. In two [illegible] the urine contained also hyaline and granular tube casts [illegible] precipitated pigment. On re-examination of the urine of these [illegible] I [illegible] and [illegible] after two to four weeks' treatment, the albumen [illegible] had disappeared and that only immaterial traces of [illegible] detected. — *S. D.*

I handed over to Mr. Heap a portion of the organ for the estimation of arsenic by the hydrochloric-copper (Reinsch-Delépine) method and he found 0.01 mg. of

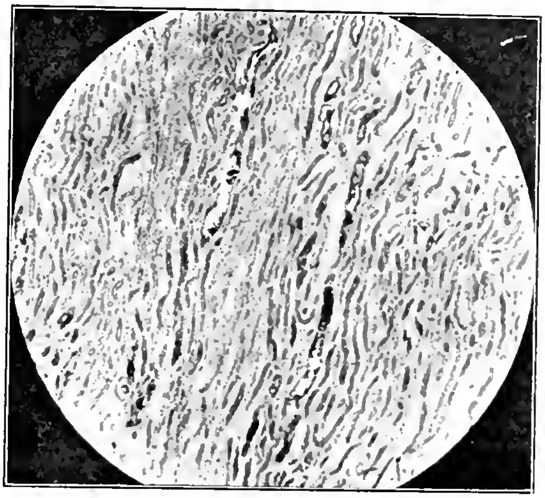

FIG. 1. — *Kidney.* Longitudinal section through the boundary zone of a malpighian pyramid, showing the accumulation of pigment in the straight tubes, and the slightness of the changes in the loops of Henle and their ascending and descending limbs. × 40.

arsenious acid in 200 gm. of liver, which makes 0.0000878 gm. for the whole organ.

Spleen. — (4 oz.) Small, shrunken looking, but normal in shape, capsule wrinkled, pulp moderately firm, more brown than usual.

Right kidney. — (8 oz.) Considerably enlarged; length, 5 inches; width of upper part, $2\frac{3}{4}$ inches. More rounded than normal, otherwise normal in shape. Surface smooth, capsule peels off readily. Small white infarct at one place. Exposed surface looks granular, owing to the whole surface being punctated by small dark brown spots, contrasting with the paler intervening cortical substance. Thickness of cortex, $\frac{1}{4}$ inch; of medulla, $\frac{1}{2}$ inch. There are in the cortex and medulla a number of spots and of straight sinuous dark brown lines, conspicuous owing to their size and to their dark brown colour which contrasts with the paler unusual brownish colour of the glandular tissue. These produce the impression that the vessels are distended with dark blood. The boundary layer of the medulla is very dark owing to the large number of these dark lines.

Pancreas. — (The only part of the organ available for examination is the tail.) Tissue firm, otherwise normal. There are several lymphatic glands conspicuous on account of their dark brown colour (possibly spleniculi) along the upper border of the pancreas.

Stomach. — Appears normal in size and shape. Mucous membrane thick and soft, mammillated at places. Some parts show some brown discolouration, possibly the result of congestion, but no characteristic lesion is obvious.

Duodenum. — The small part of the duodenum attached to the stomach is deeply congested.

Heart. — The small piece of the ventricular wall available for examination is pale, but shows no clear naked-eye evidence of fatty degeneration.

(Various parts of the organs were hardened respectively in formal, methyl-alcohol, and 2 per cent. bichromate of potash solution for the purpose of microscopical examination.)

MICROSCOPICAL EXAMINATION OF THE ORGANS

Heart. — Longitudinal section of one of the papillary muscles of the left ventricle. There is no obvious alteration of the endocardium. The muscular fibres are unequally altered, and show an abnormal degree of segmentation. In many places

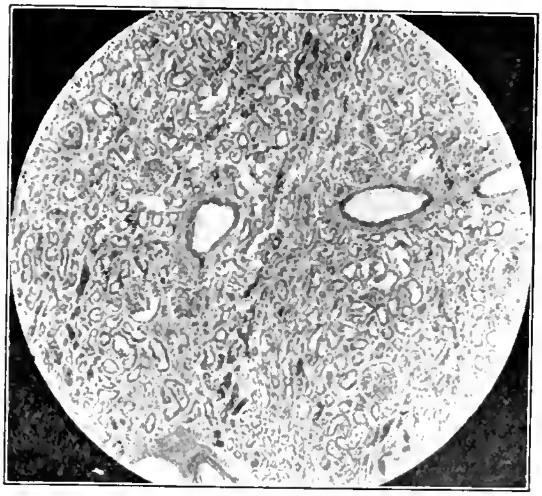

FIG. 2. — *Kidney.* Section through the deeper parts of the cortex adjacent to the boundary zone, showing the accumulation of pigment in the straight tubes and the increased size of the lumen of the convoluted tubes, due to the degeneration of the central part of the secreting cells forming their lining. × 40.

the striation is not materially altered, in other places the transverse striation is indistinct and the longitudinal exaggerated. Some of the fibres are granular, but very

few of the granules give, with osmic acid and Sudan III, a clear reaction of fat. The brown pigment granules at the poles of the nuclei are very distinct, but there is no exceptional pigmentation of the fibres. Most of the granules give a slight doubtful fat reaction with osmic acid and Sudan III.

The nuclei of many of the myocardial cells stain badly, and some not at all with

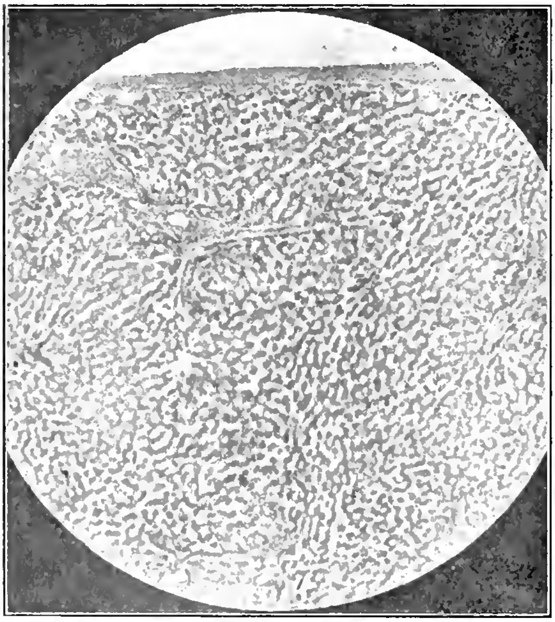

FIG. 3. — *Liver.* Section perpendicular to the surface of the organ, showing the absence of cirrhotic lesions and of general fatty lesions. The shrunken state of the liver cells and the wide spaces occupied by the intralobular capillaries and perithelial tissue are well shown. × 40.

hematein. This is particularly noticeable where the myoplasm is granular or its striation altered.

Liver. — Section perpendicular to the upper surface of the right lobe.

There is no increase of connective tissue round the portal vessels, and the liver appears to be exceptionally free from cirrhotic changes. The larger portal and hepatic vessels are generally empty. A few of them contain finely granular matter or hyaline clots, but no distinct blood corpuscles.

The blood capillaries are very much distended and generally contain swollen, decolourized, red blood corpuscles among which are a few white corpuscles, mostly small, lymphocyte-like. In several places the blood corpuscles are replaced by finely granular matter and pigment granules of various sizes. The walls of the capillaries are unusually distinct. The nuclei of the endothelial cells are small, but stain well; the space between the walls of the capillaries and the liver cells, which is indistinct in the normal liver, is very distinct in places. (This is probably the result partly of oedema and partly of the shrinking of the liver cells.)

The shrinking of the liver cells renders the arrangement of the columns which they form exceptionally distinct. Many of the hepatic cells are vacuolated. This is particularly marked in the portal zones of the lobules. The vacuoles are not generally large, but in some of the cells they are so numerous as to give the cells a spongy appearance. In some places the vacuoles are seen to communicate freely with intralobular bile canaliculi. In these cells the nuclei are indistinct or stain very faintly with ordinary nuclear stains. The contents of the vacuoles do not stain with osmic acid or Sudan III, except in some places, where a few of the smaller vacuoles (and globules at the periphery of some of the larger vacuoles) also give a fat reaction, but this is exceptional. Many of the cells are pigmented. The reddish-brown pigment is partly in the form of fine granules, such as are found in connection with cyanotic atrophy of the liver, and partly diffused through the cells. Some of the pigment granules give an ill-defined reaction of fat with osmic acid. Most of the pigmented cells are situated in the hepatic and portal zones of the lobules, but some of them are found here and there in the intermediate zone also. None of the granules give the reaction of free iron with ferrocyanide of potassium.

The nuclei of the hepatic cells are generally capable of being stained with hematein, but they stain very unequally. Their size is also subject to great variations.

A section through the left edge of the left lobe of the liver showed changes identical with those observed in the right lobe. These changes may be summed up by saying that the liver was in a state of dropsical degeneration, with considerable atrophy, pigmentation, some necrosis, and very slight fatty degeneration of the secreting epithelium.

Kidney (right). — Section perpendicular to the surface of the upper end.

The capsule is thin and apparently normal and there is no increase in the subjacent connective tissue. Deeper in the cortex there are a few small patches where

some increase of connective tissue is noticeable, and where some malpighian bodies are in a state of hyaline degeneration. The surface of the capsule is uneven owing to a large number of the subcapsular convoluted tubules being much swollen.

All the capillary and interlobular vessels are empty and some of them are contracted. The larger vessels in the sinus are also empty, but are otherwise normal. The glomerular vascular tufts are large and generally fill entirely their capsules but in some cases they are shrunken, and the space between them and the glomerular capsules is filled up with granular material. The epithelial lining of the glomerular capsules is, in many cases, thicker than normal.

The epithelium of the convoluted tubules seems in many places to be replaced by a low cubical epithelium and the lumen of the tubes to be of considerable size. This appears to be due to the breaking up in each of the cells of the half of the cell turned toward the lumen. In many convoluted tubes this central part of the secreting cells is much vacuolated, forming a spongy mass coalescing with the central parts of adjacent cells similarly affected. This spongy mass entirely fills the central part of the tubules. In other places all that remains of this degenerated part of the cells are a few irregular debris, or some finely granular material. The spiral tubes are in the same state. The limbs of the loops of Henle are less altered.

In a few of the convoluted tubes there are pigment granules of various sizes staining faintly, like red blood corpuscles with orange. Many of the junctional tubules contain numerous pigment granules, giving this reaction more clearly. The epithelium of the cortical straight tubes is much less altered than the secreting epithelium of the convoluted tubes, but the lumen is generally filled, often to distention, with round granules of yellowish-brown pigment of which some have nearly the size of red blood corpuscles, but the greater number are much smaller. All these are highly refractive and somewhat oily looking: they are brightly stained with orange, the colour being not unlike that taken by red blood corpuscles, but deeper and darker. With osmic acid and Sudan III these granules do not give the reaction of fat, but among them there are few globules which give a fat reaction A few fatty granules are also present in some of the degenerated epithelium of the convoluted tubes, but this is exceptional. Some of the granules in the lumen of a few of the convoluted tubes give a clear reaction of fat. In the larger medullary straight tubes the pigment granules are present in such numbers as to cause distension of the tubes; they also show a marked tendency to coalescence, and in the larger excretory ducts near the apex of the pyramids the epithelium is partly covered by a thick continuous layer of pigment caused by the coalescence of the granules. In a few of these tubules cast-like masses are observed.

The nuclei of the cells of nearly all of the excretory tubes stain fairly well and evenly with nuclear stains. The nuclei of the secretory cells stain more unequally, but more completely than could be expected in cells which seem to be in a state of dropsical degeneration or incipient necrosis. It is possible that necrosis of the renal epithelium is more advanced than the usual histological reactions would indicate, and that the nature of the poison has altered the usual reactions of the nucleoplasm.

None of the granules give the reaction of free iron with ferrocyanide of potassium.

Spleen. — The sections of the spleen are unsatisfactory. The malpighian bodies show no obvious change. The pulp shows the following alterations: No blood is visible in the sinuses, which are much reduced in size and contain a small amount of finely granular matter. The cells are also finely granular, but the nuclei stain well. There is no abnormal accumulation of pigment either between or within the cells.

THE HEALTH HAZARDS AND MORTALITY STATISTICS OF SOFT COAL MINING IN ILLINOIS AND OHIO

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By means of direct field investigations in which forty-three mines in Ohio and fifty-six mines in Illinois were visited, including their surrounding towns, and by means of questionnaires and conferences with officials and mining physicians, the subject of the health and hygiene of coal miners was investigated in an automobile tour during the summer of 1918. The general results of this survey have been or will be published by the Illinois and Ohio State Boards of Health, by the Health Insurance Commissions of these two states — all of which agencies were concerned in the survey — and by the author in a paper appearing in recent issues of *Modern Medicine* (June and July, 1919). The purpose of the present article is to present some of the technical findings regarding the health hazards of soft coal mining, and to give the results of the study of the mortality statistics in this occupation — features of the investigation which have not before been published in detail.

The following brief summary reviews the results of the survey as already published. In both Illinois and Ohio soft coal only is mined. The industry in these states is steadily increasing; it employs approximately 50,000 workmen in Ohio and 90,000 in Illinois. The quantity of coal in sight in both states is sufficient to last for centuries. Healthful working conditions in Ohio mines are not as good as the average of most industries in Ohio. On the other hand, conditions are good in Illinois mines. Ohio mines are shallow and of a damp, muddy type in contrast to Illinois mines which are deep and dry. Forced ventilation, required in all mines, is quite good, but the air of Ohio mines is much vitiated by the practice of shooting down coal with powder during working hours. This is not allowed in Illinois. In both states there is a shortage in the personnel of state-paid mine inspectors, and particularly in Ohio; also their salaries of $150 per month are unquestionably too low for expert men in responsible positions.

By law, Illinois mines are equipped with wash houses in which the men may bathe following work. Upwards of 90 per cent. of the men use them. Such conveniences are rare in Ohio mines. A glaring omission at practically all mines is the absence of latrines for workers on the the surface, so that the fly menace and ground pollution is bad in mining towns. Equally as bad is the drinking water supply, both for mines and towns.

The eight-hour day prevails. There was practically no overtime even during the war stress — a day shift only is maintained.

All miners are unionized. Foreigners principally Eastern Europeans and Italians predominate. But slightly over 3 per cent. of the workers surpass sixty years of age. Wages are good, but in normal times many mines are idle for weeks and months each year because of the lack of demand for coal (hence the miners' demand for a six-hour day). Disastrous strikes have also caused great suffering.

Housing conditions, and hurtful forms of recreation, especially alcoholism, undoubtedly cause the major amount of sickness. The mine itself is not an unhealthful place in which to work. Lack of interest in these districts on the part of the population of the rest of the state is a potent reason for low standards of hygiene in mining districts.

Rheumatism, "asthma," and alcoholism constitute the chief afflictions, and all are believed to be above the average. Tuberculosis and pneumonia have about the same prevalence as elsewhere. Venereal diseases are conspicuously less. Several diseases supposedly of industrial character among miners, such as hook-worm, nystagmus, and lockjaw, are practically nonexistent.

Miners have devised many schemes of sickness insurance and death insurance. None are adequate; most have a struggling existence. About 50 per cent. of native American miners carry some form of sickness insurance in locals or in fraternal societies. About 90 per cent. of foreign workers carry such insurance in religious societies. Establishment funds do not

exist. In Illinois the state miners' organization pays a death benefit of $250. In both states practically all locals also pay death benefits ranging from $25 to $200 and usually including death in the miner's family. A common procedure for aid in case of sickness is "to pass the hat." Miners often belong to several benefit societies and may derive over-insurance therefrom. The usual industrial insurance by private companies, providing a small burial fund for children, is extensive.

Practically all community medical facilities are seriously inadequate. First-aid alone is generally beyond criticism, this due to the insistence of state mine bureaus. Physical examination of employees in the mines does not obtain. In Ohio, especially, there is a general shortage of physicians and in both states nurses are practically unknown in mining towns. Nostrum and quackery propaganda flourish, although non-medical practitioners are scarce.

Health Hazards According to Occupation

The 43,637 employees (a) within the Ohio mines for the year 1917 were divided as follows:

Pick miners	5,763
Inside day hands	10,175
Loaders, drillers and shooters	23,900
Machine miners and helpers	3,799
Total	43,637

The (b) outside workers totaled 6,282.

The employees (a) within the Illinois shipping mines for the year 1917 were divided as follows:

Cagers	753	Shot-firers	546
Drivers	4,263	Timbermen	1,422
Laborers	5,660	Trackmen	2,178
Loaders	24,529	Trappers	1,251
Machine men	3,957	Unclassified	8,546
Miners	24,951		

The outside or surface workers (b) totaled 7,337.

Investigations showed the health hazards for various occupational designations to be as follows:

Cagers. — Cagers and those who push mine cars around at the "bottom" or the exit of the mine, breathe the air after it has made the complete circuit of the mine, i. e., provided the return air is by way of the hoisting shaft or the exit roadway, which is usually the case. The air movement is also brisk. Fine dust is a feature. Humidity is high. Getting wet with water drippings is almost unavoidable. The work is active, often hurried and with short forceful strains. Workers should be medically picked.

Drivers. — Drivers including motormen, trip-riders, and mule or pony men, are usually youths. The work is muddy, often also dusty, in strong drafts, and quite hazardous in regard to accidents.

Laborers. — These are scattered about over the mine and have the hazards of the places in which they happen to work.

Loaders. — These men work at the face. They load the coal, whether pick or machine mined, into the mine cars. They are subjected to air conditions of the distant interior (work rooms), and to immense amounts of dust. Their work is laborious, on the tonnage basis, and when slack periods exist they are apt to sit around in cool, damp places. The air is fresher for these workers, however, than for those located along the return air way and at the bottom of the hoisting shaft (i. e., the cagers).

Machine Men. — These men have the ventilation hazards of the work rooms and are the most subject of all workers to breathing fine dust (bug dust). Most of the work is laborious and in strained attitudes. They are usually big, powerful men. Many also work at night, the machines undercutting the coal to be mined the next day.

Pick Miners. — The work of the miner is much less difficult than before the days of the extensive use of powder. They have the ventilation hazards of the work room. The dust hazard is great. Their work is laborious, on the tonnage basis and rather monotonous, with considerable jar, much spurt work interspaced with spells of waiting for mine cars, when they are apt to sit around in cool atmospheres and damp places. The pick miner, present days, does very little work "on the solid," i. e., picking at the coal in the seam directly. He uses drills and powder for this and picks the blasted-down chunks to pieces so they may be loaded by hand into the mine cars. He may or may not be his own loader.

Shot-firers. — These men, who are found in Illinois mines, fire the shots or blasts which have been placed by the coal miners during the last part of each day. Shot-firers go from room to room after hours

and touch off the fuses. Their chief hazards are breathing the fumes after shooting (white damp) and smoke and dust. They arrange their work, however, so as to keep on the fresh air side of the ventilation.

Timbermen have the ventilation hazards of work room and entries, more or less dust, also more or less wet work in many mines.

Trappers. — These men operate track switches and doors. Much of their time is spent in waiting. They may be in strong drafts carrying various amounts of dust. They are usually youths.

Tipple Men. — These workers are on the surface at the entrance of the mine shaft and have the hazards of weather exposure, but more especially, the breathing of a great deal of coal dust; occasionally, also, smoke and fumes from the burning dump piles where these exist. The *weighmen* are usually in enclosed quarters in the top of the tipple.

Track Men. — Those on the surface move railroad cars along and spread the coal within them. They have weather exposure, and the breathing of a great deal of coal dust. Those within the mine lay and repair tracks.

Hoisting Engineers. — These men may have exposure to excessive temperatures (100 to 140° F.) where steam hoists are used — a dangerous feature, since these men must be constantly on the alert, as with their levers they guide the raising and lowering of cages by means of signals from bells or whistles. The heat comes from non-insulated steam engines and pipes which surround the engineer's platform.

Child Labor is practically no feature in Ohio or Illinois mines. Youths under sixteen are prohibited by law from entering a mine. One hazard is that youths begin work in mines, without preliminary physical examination to determine whether they are fit for such work. Slate picking is no feature in soft coal mines. All coal is picked over at the face by the loader or miner to free it from sulphur, rock, etc.

Stripping Mines. — The chief health hazards are weather exposure, particularly heat in the summer time while working in low places. Also men in steam shovels are considerably exposed to heat from furnaces. There are some risks from blasting powder fumes and dynamite.

Coal Washing. — This accessory process is carried on at a few mines. It is done on the surface in more or less open buildings. Weather exposure with wet work and a great deal of dust from the crushing processes are the chief hazards. Noise is a marked feature.

The Special Health Hazards

"Dirt" piles or Gob. — As entries and rooms are extended, the refuse ("bone") coal, slate, rock, pyrites, soapstone, clod, timbers, etc., are heaped to either side. A certain amount of decomposition takes place in this, occasionally leading to spontaneous fires usually emitting carbon monoxide from incomplete combustion and sometimes hydrogen sulphide gas. The gob crumbles up much and adds to the dust in the air and the mud underfoot, also to the danger of accidents.

Dust. — Coal dust itself is regarded as among the least harmful dusts. It creates a catarrhal condition which tends to remove it from the respiratory tract. But much crystalline and gritty dusts are breathed by the miner as well as acrid sulphur compounds. The harmful dusts may be listed about as follows in ascending order of harmfulness to the miner: coal, timber, clay, soapstone, shale, slate, softer rock, sandstone, granite, and sulphur (pyrites). The last three or four dusts are very prevalent. When breathed they tend to remain fixed in the lungs and to bring about fibrosis, chronic bronchitis, emphysema, and lymphadenitis, the whole characterized as "miner's asthma."

Illumination. — Illumination is no longer a hazard for miners since much of the bottom is supplied with electric lights and miners use the modern carbide lamps, attached to the caps. Oil lamps are all but gone. Safety lamps, fortunately, with their imperfect illumination, are not required for work in Ohio or Illinois mines. Occasionally, men complain of the glare from brilliant carbide miner's lamps, the candle power of which ranges from 4 to 6, head-on.

Heat. — Miners are not exposed to high working temperatures. Steam hoisting engineers may have undue exposure. Temperature in Illinois' deepest mine may run up to 80° F. but invariably workers are subject to less than 70° F.

Cold. — The temperature of mines is invigorating. As long as workers keep active, the rather low temperatures of themselves should be considered no hazard.

Humidity. — Dripping roofs, mud, and dampness characterize most Ohio mines.

Dryness characterizes Illinois mines, but the atmosphere of all mines is usually nearly saturated with moisture derived from the strata by the time it leaves the mine. Hence, most of the workers are in a cool moist temperature (highly contaminated with dust). The water and humidity greatly increase electrical hazards.

Fatigue. — Faulty postures while under strain and work of jarring, vibrative character, heavy lifting and the employment of a certain percentage of men ill-fitted physically for the work, are the chief hazards. The muscular fatigue, however, is probably no hazard to normal men of proper build and experience. In some mines the competition to get empty mine cars to fill, leads to much " spurt " work.

Infection. — The disposal of stools in the gob, as is the prevailing method, can be made safe. The extent to which coal mine dust may transport virulent germs, as from spitting, has not been investigated; the hazard is probably insignificant. Diseases from animals, such an anthrax, glanders, and lockjaw, the latter in spite of the presence of horses or mules in all mines, do not appear to exist. In the presence of the black plague, the rats and mice in mines would be a great menace. Injuries which miners receive are at least as free from secondary infections, if not more so, than in most classes of workers.

Electricity. — In addition to burns and shocks, and occasionally electrocutions, the witnessing of brilliant electric flashes occasions some *electrica ophthalmia* — a painful swelling of the eyes which may persist up to fourteen days. Electric lights, motors, trolleys, rails, signals and telephones are found in mines and necessarily in close proximity to workers.

Poisons. — These concern mine gases almost solely. The chief mine gases are of three types: *fire damp* (methane, " gas," CH_4) which is explosive but not dangerous to health except as it replaces oxygen and then causes suffocation; *black damp* (choke damp, where carbon dioxide and nitrogen are increased at the expense of oxygen); and *white damp* (carbon monoxide). *Stink damp* (hydrogen sulphide, H_2S) is rarely found in mines. Sulphur occurs as pyrites and in acid forms, the latter dissolved in water and often strong enough to eat holes in clothing or to cause ulcers in the eyes if gaining access to them. In dust form it irritates the throat, nose and lungs.

Assuaging of Thirst. — Questionable water supplies in many instances make miners liable to typhoid fever, dysentery, and water-borne diseases. Alcoholic beverages are not permitted while at work.

Personal Hygiene. — Miners are in great need of instruction in matters of personal hygiene and the prevention of sickness. A large per cent. of miners' illnesses could be curtailed by this means.

Mortality

The studies of mortality of soft coal miners have been based upon the figures for Illinois. Illinois leads all other states in having available (through the efforts of the United Mine Workers in the state) figures on the average number of employees at a given time in the soft coal industry, and a record of each coal miner's death for the past ten years. These records, which are even more accurate than the standard death certificate since they are checked by the Union, have resulted from the Deaths Claims Insurance maintained by the state organization by which a burial fund amounting to $250 is paid to the beneficiary on the occasion of the death of any miner. In order that former or unemployed miners may remain in good standing and thus insure the burial payment, an exoneration list is maintained to which 7 per cent. of the total number of miners belong (October, 1918). The exoneration list has extended from a former rate of about 5 per cent. of the total membership to 7 per cent. recently, because of the increased exonerations allowed for war service.

These records enabled the Illinois Health Insurance Commission and the writer to compile Tables 1, 2, 3, 4, and 5.

TABLE 1. — GENERAL MORTALITY AMONG ILLINOIS COAL MINERS

(February 1, 1912 to July 21, 1918. — Approximately 6½ years.)

Fiscal Year	Number of Deaths	Average Yearly Membership	Death-Rate per Annum per 100,000 Employed
Feb. 1, 1912–1913	742	73,955	1,003
Feb. 1, 1913–1914	800	75,161	1,064
Feb. 1, 1914–1915	825	76,093	1,071
Feb. 1, 1915–1916	784	70,903	1,105
Feb. 1, 1916–1917	832	74,942	1,110
Feb. 1, 1917–Jan. 1, 1918	893	83,489	1,167
Jan. 1, 1918–July 1, 1918	555	93,651	1,185

The last column in Table 1 shows that the death rate for Illinois coal miners has been constantly on the increase since 1912.

The marked excess in deaths due to violence nullifies to a large extent any comparisons possible between the other causes

TABLE 2.—MORTALITY OF ILLINOIS COAL MINERS FROM SELECTED CAUSES OF DEATH
(February 1, 1912 to July 21, 1912.—Approximately 6½ years.)

Cause of Death	International List No(s).	For the Four Year Period, Feb. 1, 1912 to Jan. 31, 1916[1]	For the 2½ Year Period, Feb. 1, 1916 to July 21, 1918[2]	Total Numbers of Deaths	Percentage Distribution of Deaths	Death-Rate per Annum per 100,000 Employed[3]
Typhoid Fever	1	104	50	154	2.8%	30.8
Malaria	4, 4a	6	5	11	0.2	2.2
Tetanus	24	5	1	6	0.1	1.2
Tuberculosis	28 to 35	277	221	498	9.2	99.4
Cancer	39 to 46	109	98	207	3.8	41.4
Cerebro-Spinal Diseases	60 to 79	153	135	288	5.3	57.5
Circulatory Diseases	77 to 85	212	190	402	7.4	80.3
Pneumonia	91 and 92	252	239	491	9.1	98.1
Other Respiratory Diseases	(86 to 90) (93 to 98)	158	55	213	3.9	42.6
Liver Cirrhosis	113, 113a	47	41	88	1.6	17.6
Genito-Urinary (non-venereal)	119 to 127	124	129	253	4.7	50.5
Suicide	155 to 163	102	58	160	3.0	31.9
Violence[4]	164 to 186	1,205	790	1,995	36.8	398.2
All Others	all others	408	254	662	12.2	132.1
Totals		3,162	2,266	5,428	100.2	1,083.9

[1] From figures compiled by Duncan McDonald, former Sec.-Treas., U.M.W.A., District of Illinois.
[2] From death claim records at office of Walter Nesbitt, Sec.-Treas., U.M.W.A., compiled by the Illinois Commission on Health Insurance.
[3] The average monthly number of employees throughout the whole period of approximately six and one-half years was 77,051. The casual reader should not compare the rates in this column, which are for adult males only, with the rates of death from similar causes in the population at large.
[4] "*Violence*" includes all external causes other than suicide.

Some deductions based on Table 2 may be made by comparisons with percentage distribution of deaths in other groups, as with:

(a) The U. S. Registration Area for 5,663 miners and quarrymen as given in Mortality Statistics, U. S. Bureau of Census, 1909, Table VIII, pages 402, 403 (see Table 3 below); and

(b) The U. S. Registration Area for 210,507 occupied males, 10 years of age and over, as given in Mortality Statistics, U. S. Bureau of Census, 1909, Table VIII, pages 388, 389 (see also Table 3).

While it is true that comparisons as arranged in Table 3 are not quite logical, principally because periods of even date are not compared, nor have soft coal miners been separated out of the federal figures, they are the best that can be had at present.

Violence as a cause of death in Illinois coal miners ranks 2.3 points less than in miners and quarrymen in the registration area. This cause, however, for both Illinois coal miners and miners and quarrymen is greatly in excess of the violence percentage in occupied males in the registration area (10.6 per cent of all deaths*).

* But one other occupation, steam railway employees, with 53.6 per cent of all deaths due to violence, surpasses miners and quarrymen; the next occupation to approach it is lumbermen and raftsmen—29.9 per cent. (Consult U. S. Mortality Statistics, 1909, Table VIII.

of death and the figures given under occupied males in the last column. It does not affect, however, comparisons between Illinois coal miners and miners and quarrymen.

By eliminating the distortion due to violence as a cause of death, and then com-

TABLE 3.—SOME COMPARISONS OF THE PERCENTAGE DISTRIBUTION RATES OF CERTAIN CAUSES OF DEATH FOR ILLINOS COAL MINERS AND OTHER GROUPS

Causes of Deaths[1]	5,428 Deaths Among Illinois Coal Miners, 1912–1918	5,663 Deaths Among Miners and Quarrymen, U. S. Reg. Area, 1909	210,507 Deaths Among Occupied Males, U. S. Reg. Area, 1909
Typhoid Fever	2.8%	2.3%	2.2%
Tuberculosis	9.2	8.8[3]	11.8[3]
Cancer	3.8	3.3	5.5
Cerebro-Spinal	5.3	4.9	9.8
Circulatory Diseases	7.4	8.8	16.1
Pneumonia	9.1	8.2	8.0
Other Respiratory Diseases	3.9	4.3	10.2
Liver Cirrhosis	1.6	1.0	1.8
Genito-Urinary (non-venereal)	4.7	4.0[4]	8.5[4]
Suicide	3.0	1.5	2.6
Violence[2]	36.8	39.1	10.6

[1] See Table 2 for corresponding International List Numbers.
[2] See Note 4, Table 2.
[3] *Tuberculosis of lungs* only.
[4] *Bright's disease* only.

paring the purely medical causes (with suicide included) a clearer insight is obtained of the relative importance of certain prominent death causes.

As compared to miners and quarrymen in general, Illinois coal miners *rank:* (a) *about the same* with respect to tuberculosis and cerebro-spinal diseases; (b) *more favorably* with respect to circulatory diseases and "other" respiratory diseases; and (c) *less favorably* with respect to typhoid fever, cancer, pneumonia, liver cirrhosis, genito-urinary (non-venereal) diseases, and suicide.

TABLE 4.—SOME COMPARISONS OF THE PERCENTAGE DISTRIBUTION RATES OF CERTAIN CAUSES OF DEATH FOR ILLINOIS COAL MINERS AND OTHER GROUPS, WITH VIOLENCE EXCLUDED

Causes of Deaths [1]	5,428 Deaths Among Illinois Coal Miners, 1912–1918	5,663 Deaths Among Miners and Quarrymen, U. S. Reg. Area, 1909	210,507 Deaths Among Occupied Males, U. S. Reg. Area, 1909
Typhoid Fever	4.4%	3.8%	2.5%
Tuberculosis	14.6 [2]	14.4 [3]	16.6 [3]
Cancer	6.0	5.4	6.2
Cerebro-Spinal	8.4	8.0	11.0
Circulatory Diseases	11.7	14.5	18.0
Pneumonia	14.4	13.5	8.9
Other Respiratory Diseases	6.2	7.1	11.4
Liver Cirrhosis	2.5	1.6	2.0
Genito-Urinary (non-venereal)	7.4	6.6 [4]	9.5 [4]
Suicide	4.7	2.5	2.9

[1] See Table 2 for corresponding International List Numbers.
[2] Total tuberculosis; however, probably not more than 1 per cent. is due to other forms of tuberculosis than tuberculosis of the lungs in persons of these adult age-groups.
[3] *Tuberculosis of lungs* only.
[4] *Bright's disease* only.

As compared with occupied males in general, Illinois coal miners *rank* (a) *about the same* with respect to cancer and liver cirrhosis; (b) *more favorably* with respect to tuberculosis (although the difference is not great), cerebro-spinal diseases, circulatory diseases, other respiratory diseases, and genito-urinary (non-venereal) diseases; and (c) *much less favorably* with respect to typhoid fever, pneumonia* and suicide.

Unfortunately, similar, more recent figures from the U. S. Bureau of Census have not been compiled. Mortality statistics for soft coal miners or groups with similar hazards in other states have also not been prepared elsewhere to the writer's knowledge.

* Pneumonia is said to be a common aftermath of carbon monoxide poisoning. (Glaister and Logan, *Gas Poisoning in Mining and Other Industries*, 1916, p. 109.)

Table 5 allows some conclusions to be drawn from the death rates ascertained in Illinois coal miners by causes and age-groups.

Table 5 shows two things: (1) the age-groups in which certain causes of death are emphasized in Illinois coal miners, and (2) the tendencies toward increase or decrease in the various causes of death, obtained by comparing the death rates in the last column, which are those of the last two years (1916–18), with those for the entire period (1912–18, see Table 2). From these we have the following:

1. *Tuberculosis* shows its main emphasis in the age-group, 25 to 34, with a gradual decline thereafter throughout the balance of the age-periods.

Pneumonia shows a gradual increase with age, up to the age-period, 45–54, then a gradual decline.

The figures for *other respiratory diseases* are too small for deductions, but in general show most emphasis later in life.

Cancer and *cerebro-spinal diseases* both show a marked increase in the age-period, 35 to 44, then a more gradual increase to the age, 64, after which there is a drop.

Circulatory diseases are emphasized from 45 years of age up.

For *liver cirrhosis* the figures are too limited for discussion.

The *non-venereal genito-urinary* diseases, *Bright's disease* principally, show a gradual increase by age-periods up to and including the age-period, 55–64.

The figures for *suicide* and *violence* were not compiled for age-periods.

"*All other diseases*" have a very even distribution throughout the age-periods, there being emphasis on the period, 25–34, and less emphasis on the period, 55–64.

2. Comparing the last column in Table 5 with the last column in Table 2, it is seen that for Illinois coal miners the death rate per 100,000 employed is apparently on the increase in the case of the following diseases: tuberculosis, cancer, cerebro-spinal diseases, circulatory diseases, pneumonia, liver cirrhosis, genito-urinary (non-venereal) diseases, and violence.

Deaths from the following show a decreasing tendency: "other respiratory diseases" and suicide.

It is hardly more than speculation to attempt to state to what the apparent increase in mortality among Illinois coal miners is due. Violence as a cause of death has not increased materially. Working conditions are undoubtedly getting better from year to year. Unquestionably, it cannot be charged to any single factor, such as alcoholism, which has been on the decrease throughout the period covered in the tables; nor fatigue, since work hours have

decreased while the assistance of blasting powder and machinery have increased; nor, with the exception of certain diseases like typhoid and malaria, has geographical distribution in the state anything to do with it.

It is probable that more are reaching the later age-periods when deaths are more frequent, since the industry is not, in its present dimensions, more than a generation old in Illinois and barely more so in Ohio.

TABLE 5. — MORTALITY OF 1889 ILLINOIS COAL MINERS GROUPED BY CAUSES AND AGE-GROUPS

(Figures cover the two year period from July 22, 1916 to July 21, 1918.)

Age-Groups	15–24		25–34		35–44		45–54		55–64		65–Over		Age Not Given		Total		Rate per Annum per 100,000 Employed[3]
Causes of Death[1]	No.	%[4]	No.	%[4]	No.	%[4]	No.	%[4]	No.	%[4]	No.	%[4]	No.	%[4]	No.	%[5]	
Tuberculosis	26	14.6	47	26.4	35	19.6	33	18.6	24	13.4	13	7.3	0	..	178	9.4	106.5
Cancer	0	0	7	9.2	15	19.7	20	26.3	22	28.9	12	15.7	0	..	76	4.0	45.4
Cerebro-Spinal Diseases	9	7.6	9	7.6	24	20.5	25	21.3	27	23.0	22	18.8	1	0.9	117	6.1	70.0
Circulatory Diseases	6	3.9	17	11.2	18	11.9	36	23.8	38	25.1	36	23.8	0	..	151	7.9	90.3
Pneumonia	10	5.0	36	18.1	39	19.6	49	24.7	38	19.1	26	13.1	0	..	198	10.4	118.5
Other Respiratory Diseases	1	2.2	6	3.3	4	8.8	11	24.4	7	15.5	16	35.5	0	..	45	2.3	26.9
Liver Cirrhosis	3	8.1	2	5.4	9	24.3	8	21.6	12	32.4	3	8.1	0	..	37	1.9	22.1
Genito-Urinary (non-venereal)	2	1.9	9	8.8	11	10.7	19	18.6	38	37.2	22	1.5	1	1.0	102	5.3	61.1
Suicide	..	..	..	..	..	..	..	..	..	..	..	..	..	..	49	2.5	29.3
Violence[2]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	676	35.7	404.6
All Other Diseases	41	15.7	55	21.1	44	16.7	141	15.7	32	12.3	42	16.1	5	1.9	260	13.7	155.6
Total	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,889	99.2	1,130.2

[1] See Table 2 for corresponding International List Numbers.

[2] See Note 4, Table 2.

[3] The average monthly employment was 83,537 men. The casual reader should not compare the rates in this column, which are for adult males only, with the rates of death from similar causes in the population at large.

[4] Per cent. here means the distribution of deaths by age-groups per 100 deaths from the given cause.

[5] Per cent. here means the distribution of deaths by causes per 100 deaths from all causes.

It is probable also that a change in racial complexion to a greater percentage of foreigners is a factor. It is more than likely that a greater congestion of population and its attendant evils, without a corresponding increase in health supervision of housing and living conditions, are potent and basic factors.

The 1889 deaths occuring in the two-year period, July 22, 1916 to July 21, 1918 (see Table 5), were classified also by the twelve districts composing the coal field of the state. Without exhibiting a table, the following was deduced: With the exception of the few deaths recorded from malaria and typhoid fever, which have locality emphasis, all the remaining causes of death were fairly evenly distributed in proportion to the number of miners in each district.

The death rate of Illinois coal miners from specific causes (Table 2) when compared with the same for the entire U. S. Registration Area (Mortality Statistics, 1916, p. 19) *is directly excessive* for the following diseases: typhoid fever, 30.8 *vs.* 13.3; cirrhosis of liver, 17.6 *vs.* 12.3; suicide, 31.9 *vs.* 14.2; and violence, 398.2 *vs.* 90.9.

Summary of Mortality Statistics

1. The annual death rate of Illinois coal miners is steadily increasing.

2. Death rate comparisons with exactly similar groups elsewhere cannot be made because similar statistics elsewhere have not been compiled. The percentage distribution of deaths from different causes shows that rates for Illinois miners are about the same as for miners and quarrymen in the registration area, 1909, and that for this class of employees, external causes (violence) make up nearly two-fifths of all deaths, whereas violence for all occupied males makes up but one-tenth of all deaths.

3. By eliminating the distortion due to violence as a cause of death, it is found that the percentage ratios for specific medical causes of death show (a) insignificant differences as between Illinois coal miners and quarrymen in the registration area, but (b) rather remarkable differences as between Illinois coal miners and all occupied males. In particular, Illinois coal miners have a tuberculosis percentage not much under that of all occupied males, while their figures for circulatory diseases are much lower, but those for typhoid fever, pneumonia and suicide are much higher.

4. Tuberculosis, as elsewhere, shows its main emphasis in the age-group, 25 to 34 years. Pneumonia shows its emphasis in the age-group, 45 to 54 years.

5. All the specific causes of death discussed (Tables 2 and 5) show a tendency to increase as years go by with the exception of "other respiratory diseases" and suicide. The causes for these tendencies are undoubtedly many and complex.

6. With the exception of typhoid fever and malaria none of the specific causes of death are emphasized in any particular locality of the coal field.

7. When compared with the rates for the entire population in the registration area, the death rates for Illinois coal miners are directly excessive from typhoid fever, liver cirrhosis, suicide and especially violence.

Suggestions for Improved Health Conditions in Mining Centers

1. Insist on extending the principles of rural sanitation to mining towns.

2. There should be a community health service organization.

3. More aid should be extended to the respective state mining departments, particularly in the nature of hygienists' services. There should be closer co-operation with state health departments.

4. There should be a standardization of the many existing forms of health or sickness insurance which now prevail.

5. The author advocates state health insurance and the doing away with optional memberships.

6. More hospital, dispensary, nursing, diagnostic, and social services.

7. Physical examinations, particularly at the time of employment and preferably by state or federal employment agencies.

8. Limitation of nostrum and quackery propaganda.

9. Propaganda in health standards and ideals.

10. Promotion of Americanization, particularly in districts of foreigners.

11. All persons or service shaving to do with sanitation or medical care should be licensed, and preferably annually, as a check against unscientific methods.

BOOK REVIEWS

The Shop Committee, a Handbook for Employer and Employee. By William Leavitt Stoddard, Administrator for the National War Labor Board, 1918–1919. Pp. 100, with appendix. New York: The Macmillan Company, 1919.

As the writer points out in the foreword, this book is the result of his experiences with the War Labor Board and as an independent student of the problems of the shop committee. Aside from the fund of valuable information and conclusions which Mr. Stoddard has so ably presented, the book possesses an atmosphere of enthusiastic familiarity with the subject of shop committees, which makes its reading unusually pleasant.

After discussing briefly the history of the shop committee movement as exemplified in the Colorado plan, the British experiences growing out of the Whitley report, and the work of the War Labor Board in this field, Mr. Stoddard takes up in some detail the plans followed by the War Labor Board in directing the organization of shop committees. After following the development of the Pittsfield plan, the principles of general procedure arrived at by the War Labor Board are given.

Among the important characteristics of the shop committee given under the treatment of "General Principles" should be noted the following: "In the shop committee system government, there are two sources of power." "The relations between employer and employee . . . are controlled jointly or collectively *up to a certain point only*." "Within certain limits of common sense every employee should have the right to vote." No shop committee system can succeed where the management considers itself morally or intellectually the superior of the men.

From the discussion of general principles, the writer proceeds to details closely connected with them. Among these are the questions of representation, election machinery, and methods of procedure. The latter part of the book also deals with plans illustrative of variations of the War Labor Board's policy in organizing shop committees.

If the text of this excellent little book could be summed up in a single word, the word would be *co-operation*. The necessity for a feeling of mutual sympathy and a willingness to compromise is constantly held before the reader.

Mr. Stoddard is extremely hopeful for the future of the shop committee. He sees no fundamental antagonism between the shop committee and labor unions. On the contrary, he feels that the shop committee is the first effective agency which has come into existence with a purpose sufficiently broad to reconcile organized labor on the one hand and organized capital on the other. — *C. H. Paull.*

The Blind: Their Condition and the Work Being Done for Them, in the United States. By Harry Best, Ph.D. Cloth. Pp. 740, and index. New York: The Macmillan Company, 1919.

This is a very thorough treatise of the status and treatment of the blind in the United States, containing full statistics covering every possible phase of the subject, with recommendations based upon observations made and with very full bibliographical notes accompanying the treatment of each subject.

The work is divided into seven parts. *Part I* takes up the general condition of the blind: how many there are in the United States; their position in society; their legal status; their economic condition; and the cost of blindness to the individual and to the state. *Part II* takes up the possibilities of prevention of blindness — the object of foremost concern to the author. This involves a careful examination of the causes of blindness, and the proportion of cases preventable by present known means; of the extent and manner of preventing accidents and injuries to the eye; and of the organized movements set on foot to prevent blindness. *Part III* takes up the provision made for the education of blind children. *Part IV* takes up the intellectual provision for the adult blind. *Part V* is concerned with the material provision made for the blind: (1) the special homes for the blind; (2) the special industrial establishments; (3) all other forms of industrial provision for the blind in the general normal industrial ranks of the community; (4) pensions for the blind, the extent to which this system has already been developed, and its advisability; (5) the system of indemnification, applicable in three forms, i. e., through suits at law, personal insurance, and workmen's compensation laws. *Part VI* is a description of the various organizations which have been established to promote the general welfare of the blind, including private associations and public commissions. The special provisions made by the national government for persons blinded in military service are also reviewed. *Part VII* sets forth conclusions reviewing the work for the blind as a whole in the United States, and the manner in which existing methods of relief may be improved.

For the industrial manager interested in the prevention of blindness and in the material provision for those who have become blind, *Part II* and *Part V* will prove of particular interest. — *L. A. Shaw.*

BOOKS RECEIVED

Books received are acknowledged in this column; and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Helping France. A Story of the Red Cross in the Devastated Area. By Ruth Gaines. Cloth. Pp. 235, with illustrations. New York: E. P. Dutton & Company, 1919.

New Towns After the War. An Argument for Garden Cities. By New Townsmen. Paper. Pp. 84. London: J. M. Dent & Sons, Ltd., 1918. New York: E. P. Dutton & Company.

Government Control of the Liquor Business in Great Britain and the United States. By Thomas Nixon Carver, Professor of Political Economy, Harvard University. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 13. Edited by David Kinley, Professor of Political Economy, University of Illinois: Member of Committee of Research of the Endowment. Paper. Pp. 192. New York: Oxford University Press, 1919.

LECTURES BY DR. T. M. LEGGE*

Harvard University announces the following lectures by Dr. T. M. Legge, Chief Medical Inspector of Factories and Workshops in Great Britain.

Lowell Lectures of the Lowell Institute

To be given in Huntington Hall, 491 Boylston Street, Boston, Mass., at 8 P.M., as follows:

1.	Monday, Nov. 17.	Industrial Diseases under the Medieval Trade Guilds.
2.	Thursday, Nov. 20.	The Spirit of Work under the Medieval Trade Guilds.
3.	Monday, Nov. 24.	Modern Industry and Art.
4.	Wednesday, Nov. 26.	The Edward Medal and Gassing Accidents.
5.	Monday, Dec. 1.	Industrial Poisons and their Prevention.
6.	Thursday, Dec. 4.	Anthrax.

The Cutter Lectures on Preventive Medicine and Hygiene

To be given at the Harvard Medical School, Amphitheatre Building E, 240 Longwood Avenue, Boston, Mass., at 5 P.M., as follows:

1.	Tuesday, Nov. 18.	Twenty Years' Experience of the Notification of Industrial Diseases under the Workmen's Compensation Act.
2.	Wednesday, Nov. 19.	Industrial Diseases under the Workmen's Compensation Act.
3.	Friday, Nov. 21.	Medical Supervision in Factories.

* Owing to unexpected demands on Dr. Legge's time, at the eleventh hour his lectures have had to be postponed to somewhat later dates. The Journal of Industrial Higyene will be glad to send to anyone requesting such information, the dates of the lectures when finally scheduled. — *Ed.*

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of JOURNAL OF INDUSTRIAL HYGIENE, published Monthly at Boston, Mass., for October 1, 1919.
State of New York ..... } ss.
County of New York }

Before me, a notary public in and for the State and county aforesaid, personally appeared J. Norris Myers, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the JOURNAL OF INDUSTRIAL HYGIENE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Macmillan Company, 64–66 Fifth Ave., New York City. Editor, Dr. David L. Edsall, 240 Longwood Ave., Boston, Mass. Managing Editors, Drs. C. K. and K. R. Drinker, 240 Longwood Ave., Boston, Mass. Business Manager, J. Norris Myers, 64–66 Fifth Ave., New York City.

2. That the owners are: The Macmillan Company (Inc.), 64–66 Fifth Ave., New York City. Stockholders owning more than 1 per cent. of stock are: Maurice Macmillan, 52 Cadogan Place, London, S. W., England. Sir Fred'k Macmillan, 22 Devonshire Place, London, W., England.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustee, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is Monthly. (This information is required from daily publications only.)

THE MACMILLAN COMPANY
J. NORRIS MYERS, Bus. Mgr.

Sworn to and subscribed before me this 18 day of September, 1919.

H. W. MYERS
(My commission expires March, 1920.)

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NATIONAL SAFETY COUNCIL NUMBER

THIS issue of the JOURNAL OF INDUSTRIAL HYGIENE is devoted exclusively to the publication of papers delivered before the Health Section of the National Safety Council at the Eighth Annual Safety Congress held in Cleveland, Ohio, October 1–4, 1919.

WHAT THE NATIONAL SAFETY COUNCIL IS

THE National Safety Council, 168 North Michigan Avenue, Chicago, Ill., is now the leading organization in the United States for the prevention of accidents in the industries, the streets and the homes. Starting in 1913 with forty members, it now has a membership of over 3700 factories, railroads, insurance companies, technical schools, governmental agencies, etc., employing an aggregate of more than 6,000,000 workers. Its income is derived solely from membership dues. It does its work without asking for profit. It is co-operative, non-political, non-commercial. Practically all the coal mining companies, manufacturing concerns and railroads, both large and small, which have obtained the best results in accident prevention are members of the National Safety Council.

WHAT THE NATIONAL SAFETY COUNCIL DOES

1. Maintains bulletin service. Three posters suitable for posting on bulletin boards, where the messages of care and caution may come directly under the notice of the workmen, are issued each week. One bulletin is issued each week for the executives, bringing to their attention the latest and best plans, methods and ideas for getting the best results from safety work and from other industrial relations activities.

2. Maintains Information Bureau for answering inquiries on all phases of safety work, sanitation, industrial hygiene and other branches of industrial relations. The Council also maintains a complete and comprehensive library on safety which is available to its members.

3. Publishes Safe Practices pamphlets monthly. These engineering studies of industrial hazards are written in plain, everyday English so that they can be understood by every foreman.

4. Lends safety motion picture films and stereopticon slides for use at workmen's safety meetings and other occasions.

5. Provides phonographic safety talks, prepared by well-known safety men, for use in lunch rooms and at meetings of foremen, safety committees, workmen and others.

6. Maintains Employment and Registration Bureau for Safety Engineers.

7. Conducts a Speakers' Bureau and gives training courses for safety supervisors. Also co-operates with technical colleges and universities in presenting safety as part of a course in engineering.

8. Aids in the organization of state and local councils in various parts of the country. At the present time there are thirty-five such state or local councils.

9. Prints weekly news-letter to keep members informed on current events and important matters affecting the safety movement.

10. Conducts the Annual Safety Congress in some large industrial center, where papers and discussions on all branches of accident prevention work are given by experts of national and international reputation and where comprehensive exhibits on safety and other questions relating to industrial relations are shown. The Congress at St. Louis in 1918 was attended by over 1700 persons. The Proceedings of the Congress are printed and sent to members. They contain 1200 pages of information which is invaluable to the person who wants to study safety.

INDUSTRIAL HEALTH HAZARDS*

CHARLES A. LAUFFER, M.D.

Medical Director, Relief Department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

THE human dynamo generates a fixed quota of energy. If speeded up, it stands a determinable overload with immunity; if given rest periods, kept in repair, and properly sustained, the human dynamo will last three score years and ten, probably longer. The overloaded dynamo develops heat, in consequence of which wear and tear is greatly accelerated: if temperature readings show that the dynamo heats up too much, an early breakdown can be definitely predicted. The same applies to the human dynamo in which physical defects and psychic maladjustments, as well as speeding up, overloading, and shortened rest periods, develop "heat," known as fatigue.

Modern industrial developments, collecting vast multitudes of men and women in industrial establishments, bring to the forefront the problem of health hazards. The vast exodus from rural to urban life, during the past generation, forcing into indoor occupation individuals whose ancestors for generations lived out of doors, has further emphasized the problem of health hazards.

A study of these problems is vital to the employee; health, long life, and happiness are involved. It is fundamental to the employer; increased production, diminished labor turnover, contented ranks of healthy, happy, veteran employees — all tending to increased profits.

The employee asks for himself and his sons: Is it a safe industry in which to seek employment? Is there any special liability of incurring a trade disease? Or of suffering early impairment in health? In short, what are the health hazards of this and that industry?

Industrial Health Hazards of Employees

I. The industrial health hazards of the employees may be grouped as arising from:

1. Poisons, dusts, fumes, gases.
2. Heat, humidity, ventilation.
3. Lighting.
4. Crowding.
5. Fire peril.
6. Association with diseased employees.

The Harvard Chart gives a readily accessible grouping of the industrial poisons; a consideration of all of them would be out of place in this connection. Lead, arsenic, and mercury cause definite toxic effects, when absorbed by workers in these metals. The most used poison is lead. Not every employee who handles a paint brush, however, gets lead colic; some paints are innocent of lead, yet employees, who have never touched lead, will bring in diagnoses of "lead poisoning," merely because an attending physician knows they are painters. Lead storage in the tissues may ensue when lead is carelessly handled, yet lead poisoning is practically unknown in large plants handling hundreds of tons of lead every year. The extent of industrial lead poisoning, we know, is much less than some reports would have us believe. Employees who cannot be taught to wash their hands before eating, and who never clean their finger nails, nor care for their teeth, are particularly liable to lead poisoning. Lead cannot be eaten with immunity, within or without the industries, but with individual co-operation, plus careful industrial supervision, the lead hazard can be mitigated. Precautions in handling lead reduce, almost remove, the health hazard from this source. Individuals who have once developed toxic lead symptoms should be given other employment, as the poison is cumulative and is never entirely eliminated, hence relapses readily occur, making permanent transfers to other lines of work necessary.

Persons having a tendency to eczema or furunculosis may develop a skin rash from the solvents employed in removing varnish, shellac, and various insulation dope. Cutting oils, recovered by centrifuge methods, provoke skin infections; forced filtration through successive layers of filter paper removes minute metallic spicules, and filters out bacterial flora that affect the skin. Cutting compounds are often culture media for pathogenic bacteria, and may require sterilization, — by heat, chemical, and

* Read before the Health Section of the National Safety Council, Eighth Annual Safety Congress, Cleveland, October 3, 1919. Received for publication September 30, 1919.

filtration methods. Minute burns from flying hot chips, abrasions by metallic spicules in dirty cotton waste — used in rubbing hands and arms — rough scrub-brushes or caustic soaps may provoke such dermatitis. Every industry has its own problem, or succession of problems, in this line. Persons manifesting such susceptibility should be transferred to other lines of work; some individuals can work in chemicals for months without developing trade dermatoses, while others develop such trouble quickly. When 150 employees are subjected to the identical exposure, and only three develop industrial dermatoses, the factor of personal susceptibility is suggested. Attention to the toilet — thorough, careful cleansing of the skin — tends to reduce industrial dermatoses.

Dusts and fumes are drawn out at their source in the well-equipped modern factory, so that the factory atmosphere is, or can be made, relatively clean. There are justifiable grounds for pride, where a wholesome factory atmosphere is maintained. The competition between factories to make working conditions the best possible has not yet been overworked, and can be promoted to the mutual advantage of both employee and employer. It is up to the initiative of employers, co-operating with architects, ventilating, heating and lighting engineers, and employees' committees, to make working conditions safe from the health standpoint.

Pulmonary tuberculosis should be mentioned, in its relation to dust and fumes. Dusts in themselves are not infectious. Dusty air is not salubrious, but with the dust evil minimized, as in modern industries, there are few occupations that can be condemned as unfit for healthy men.

We are told that guinea pigs, kept in cement mills, develop no calcicosis, and employees seldom do. While the controversy over cement dust still rages, its dangers are less excessive than some have imagined. The dust menace in other trades is, in comparison, relatively negligible. Coal miners develop more or less anthracosis; iron workers may develop siderosis. Marble cutters formerly developed calcicosis, which health hazard is now much reduced by suction devices for the removal of dust at its source. The inhalation of foreign particles — such as coal, iron, stone, textile fibres, animal hairs and furs, grain dust — gives rise to pigmentation of the lungs. This pigmentation in itself is of no consequence and everybody has it to some extent.

Dusts are mostly filtered out in the nose; if the dusts reach the bronchial tubes, they are caught in the bronchial cellular cilia, and coughed up, being expectorated with the bronchial secretions. It is contended that none of the dust reaches the alveoli. Particles that reach the peribronchial lymph-nodes, and the mediastinal lymph-nodes penetrate through lymph channels from the bronchia.

Pulmonary pigmentation and lymph-node infiltration are not dangerous until tubercle bacilli have been implanted. Where has this or that victim of pulmonary tuberculosis acquired his disease? There is no definite period of incubation for pulmonary tuberculosis. So much time elapses between the exposure to the tuberculous infection, and the frank incidence of the disease, that the real source of infection may have passed unobserved. The tubercular area can be walled off for many years, lying dormant all that time, but finally there may occur a dissemination from the old focus of infection. Some observers go as far as to say that the primary tubercular invasion occurs before the fifteenth year, before tissue immunity is established, and that the tubercular manifestations of later life are but recurrences of the earlier tuberculosis.

A survey of pulmonary tuberculosis in a textile industry, in which dust inhalation was the alleged cause of the disease, demonstrated that 85 per cent. of the cases investigated showed a tuberculous near relative, or other immediate household source of infection. The remaining 15 per cent. had a more remote source of tubercle bacilli infection, not revealed in this casual survey. The modern consensus of opinion has declared organic dust harmless; there is, consequently, no tuberculosis hazard from the textile industries. A study of pulmonary tuberculosis incidence on the basis of occupation, as afforded by the great sanitaria at Cresson, Mount Alto, and Hamburg, Pennsylvania, conclusively demonstrates that no occupation is exempt; the great white plague can be fastened on no single industry, nor group of industries.

The classes of employees that recruit the tuberculosis army are chiefly those that have relapses of old tuberculosis; those

with tuberculous wives; those living in houses infected with tubercle bacilli; those that have in other ways been exposed to the insidious, slow-acting infection.

Associating at work, or anywhere else, with persons having active pulmonary tuberculosis is a menace to health. Non-tuberculous employees should be spared the hazard incident to working near employees who are coughing and spitting in the active stages of pulmonary tuberculosis. Health service measures within the industries prevent their employment, and endeavor to isolate employees suffering from active pulmonary tuberculosis and other communicable diseases. As no such supervision is exerted over the home life, street cars, theatres, etc., it follows that the factory environment is relatively free from the peril of tuberculosis, and other communicable diseases.

Tuberculous individuals often gravitate to industries where the jobs are light, and the work within their ability. In the quiescent stages of their disease, these men should be employed. Moreover, many employees work indoors who should work outdoors. The high incidence of pulmonary tuberculosis attributed to certain industries requires appreciative consideration, as an industry is scarcely responsible for an injudicious choice of occupation on the part of an employee, suffering from, or predisposed to, pulmonary tuberculosis.

Tuberculosis is a house disease; indoor life is largely responsible. It cannot be fairly classed as a trade disease. The purely industrial diseases are but a fraction of a per cent. of the sum total of industrial morbidity; they are but a drop in the bucket. The preventable diseases, non-industrial in source, loom large in comparison. Teeth and tonsils, "coughs and colds" cause a hundred times as much sickness in the general industries as do the industrial poisons.

The segregation and isolation of persons with "colds" is considered good practice, as "colds" are "catching." "Coughs" and "colds," moreover, are communicated by crowding together in factories, and susceptibility to such infections is heightened by poor ventilation, drafts, overheating, neglect of humidity control. These problems of engineering, successfully solved, make the factory atmosphere safe and minister to the health and comfort of all persons concerned.

Industrial Health Hazards of Employers

II. The industrial health hazards of the employers may be grouped as:

1. Decreased production; machines lie idle; sick employees are irregular, discouraged, lack "pep."

2. Excessive labor turnover, due to ill health, unfitness for jobs assigned, prevalence of epidemic and infectious diseases.

3. Increased accident compensation expenditures, due to sickness masquerading as injuries. Cases arise daily, where conditions are pathological, but trauma is alleged; or in which a minor trauma has provoked a prolonged period of disability or an unusual degree of permanent impairment follows injuries, not in consequence of the gravity of the injury, but owing to intercurrent disease, or the previously impaired vitality of the traumatized individual.

The government employs only healthy men for the fighting line, whose ability to recover from wounds is 100 per cent. plus. The industries necessarily employ many aged and feeble men, suffering from latent diseases and infirmities, having enfeebled powers of resistance, and incurring delayed recoveries when injured. The industries are consequently entitled to sympathetic consideration in the vast economic problem evoked by injury plus sickness. A term of disability may start as an industrial accident, the trauma being admitted, yet the period of disability is prolonged indefinitely by complicating sickness, due to latent disease, activated by the trauma, or is prolonged by sickness arising from other causes, or from pre-existing diseases, unrelated to the trauma sustained. Fully "fifty-seven varieties" of sickness are presented as industrial accidents in entering compensation claims. Among these may be mentioned tuberculosis; syphilis — in various disguises; rheumatism — teeth, tonsils, gonorrhea, — each contributing their quota. These latent diseases, and others, are readily activated by trauma.

Remedies Suggested

III. Since these health hazards face the industrial manager, what can be done about it? How can they be avoided? Measures to this end are:

1. *Industrial Health Clinics,* group diagnoses; health service measures; repair-

ing defects; reclaiming those disabled by diseases, as well as those crippled, and fitting them into selected positions in the industries; health education.

2. *Legalized releases for defects that cause abnormally long periods of accident disability.* Hernia, varicocele, varicose veins, healed tubercular foci in joints, lungs, etc., valvular heart defects, eye defects, amputations, etc., should be charted, and an employer not made financially responsible for defects and diseases arising from causes unrelated to the employment, nor for aggravations of the same.

3. *Obligatory Post-Mortems.* When the cause of death is in dispute, the report of the post-mortem should terminate the controversy. So many deaths, occurring from pathological causes, but reported as arising from accidental injuries received in the course of employment, make post-mortems essential, if justice is to be done all parties.

4. *Federal Health Charts.* Transient employees lose a day undergoing the physical examination that precedes their employment. A federal health chart, renewed annually, valid everywhere, would be invaluable for the transient worker, as well as for the continuous worker who remains loyally by his employer year after year. The onus of the physical examination should be removed from the industries. Proper placement in industry requires the truth about physical defects. The truth, concealed, works the greatest health hazard to the prospective employee.

An annual health inspection by the staff of a diagnostic clinic for every citizen between 18 and 55 could be achieved under federal supervision. The Surgeon General's office could establish in every community a federal "Good Health" station, emphasizing diagnosis, and could recommend such remediable measures as the health maintenance of every citizen of draft age requires, both for industrial service and for war. The early correction of defects is desirable; the early recognition of incipient diseases leads to successful treatment.

Annual re-examinations would constitute a splendid follow-up system, to ascertain whether recommendations made as to teeth, tonsils, hernia, varicocele, etc., diet, exercise, etc., had been followed out.

Nation-wide federal health service, devoting its energies to diagnosis, would not interfere with existing agencies for the treatment of medical and surgical cases, hence would not in any manner antagonize practitioners of medicine, existing sanitaria, and hospitals. A federal educational propaganda for good health, however, could rapidly reduce the percentage of remediable defectives in the nation by thus recommending and by so arousing public opinion as to enforce remediable measures in the incipient stages of defects and disabilities.

Federal health charts, with photos, finger prints, and complete data of physical findings, would aid employment agents in rapidly placing men in the industries, so that they would stay placed; health charts would not debar worthy men from the industries, but would facilitate in so placing them that their defects and morbid tendencies would militate least against them.

The proposed health charts could be the means of tabulating the availability of men for military service, hence would serve the exigencies of war preparedness when men of draft age are again called out; they would likewise serve the industrial purposes of peace.

The day may be near, or remote, when a United States cabinet officer presides over a Department of Health; or when the Surgeon General of the Army is represented by a personnel as numerous and as widely distributed, as that of the Postmaster General. Federal health charts, however, and the universal diagnostic clinic service which would make such charts possible are, however, devoutly to be desired; and until obtained, physical examination must be conducted within the industries as at present in a fragmentary and incomplete manner — or extended, if possible. If conducted with the frantic haste that too often has characterized these examinations in the past, the same indifferent valuation will adhere to this service as heretofore.

Other Health Hazards of Employees

IV. Employees encounter health hazards apart from industrial service that revert back, affecting their industrial life. Such health hazards may be grouped as:

1. *Inherited Tendencies.* Bad or indifferent physical and mental endowment.

2. *Family Problems.* Unhappy home life menaces industrial safety and health.

3. *Financial Problems.* Worry over bad

investments, high cost of living, wife's or children's extravagance, or other matters, may induce more fatigue than the day's work.

4. *Social Life.* An employee may belong to too many things, and be too popular, losing too much sleep. An employee's occupation may have less to do with his health, and his continued industrial efficiency than the way he spends his evenings.

5. *House Problems.* Individual houses, affording every family its own home, are desirable in sewered towns with paved streets. Crowded tenements and boarding houses contribute to health impairment.

6. *Community Health.* The acute infectious diseases encountered in the industries of any community are a reflection of the diseases then prevalent in that community. Measles, mumps, typhoid fever, scarlet fever, influenza, grip, "colds," bronchitis, pneumonia, smallpox are encountered. Isolated cases of these diseases, sometimes endemics, sometimes epidemics, occurring in industrial plants, are traceable to community sources of infection.

7. *Neglect of Personal Hygiene.*

(*a*) Neglected teeth. The neglect of teeth among industrial workers is appalling. Putrescent stumps, dental abscesses, pyorrhea, and incomplete dentures are common; money is spent more cheerfully for almost everything else than for dental prophylaxis and dental repairs. The teeth constitute the first line of defense in conserving the digestion; swallowing food swarming with myriads of bacteria from putrescent teeth causes indigestion. No man would buy a horse that has lost its teeth. "Life is digestion"; our strength and energy come from our food yet some men are so unreasonable as to attribute their ill health and impaired strength to their work, while neglecting their teeth, thus denying their bodies the rejuvenation that comes from wholesome food, thoroughly masticated, and thereby properly prepared for assimilation.

(*b*) Diseased tonsils. Tonsillar infections, both by local and by referred manifestations, cause much loss of time in the industries. The alleged injuries, in which there are no visible nor palpable evidences of trauma, such as alleged sprained back (lumbago), alleged sprains of shoulder, elbow, wrist, ankle, as well as the several types of arthritis, rheumatism, and neuritis, have the tonsils as possible portals of entry for the infection.

(*c*) The venereal peril. All three venereal diseases, in their infectious stages, should bar employees from industry. Stricture and other complications cause lost time years after the gonorrheal infection has been forgotten. The bone injuries of old syphilitics; syphilitic leg ulcers masquerading as injuries; gummata and sinuses, presenting long terms of disability and arising from slight injuries; serious results in mild eye injuries — all, if recorded in detail, would attest the excessive liability to injury, and the poor recoveries registered by syphilitic patients in the industries. Wassermann tests, as a routine hospital measure, are in order.

(*d*) Physical defects, such as hernia, eye strain, etc., are known to exist and yet repair and corrective measures are postponed.

(*e*) Constipation is woefully neglected.

(*f*) Neglect of home sanitation, ventilation, etc.

(*g*) Balanced diet is unobserved.

(*h*) Deficient sleep.

Most men before thirty are second-raters, or third-raters; physical defects exist, and morbid processes are implanted from early life, frequently before the industrial age. Physical examinations in the public schools are often farcical; many remediable defects are overlooked, those encountered are merely reported to parents who infrequently act upon such suggestions. Consequently, the industries receive multitudes of second-raters, who develop into third-raters, who, had their defects been corrected early and had their mode of life been more hygienic, could give a better account of themselves.

An employee spends only eight or nine hours in industrial service; in his home life, community, and social life, during the other fifteen or sixteen hours of the day, he likewise incurs health hazards. The superior lighting, heating, and ventilating systems installed in many modern factories make these industrial plants more hygienic from a public health standpoint than the homes, movie theatres, and churches, many of which are more crowded and worse ventilated. To be consistent, homes, boarding houses, hotels, theatres, clubs, etc., in which employees spend more hours than in the factory, should be scrutinized and inspected as industrial plants now are, in probing sources of health impairment, and routes of infection from communicable diseases.

The industrial sick rate is augmented by a variety of physical defects, most of which are remediable, and those which cannot be cured can be adequately relieved to enable employees to keep at work, if they so elect. A man must be reasonably healthy to be an efficient worker. A small maladjustment, a minor neglect, will sometimes lead to serious complications. An employee with a toothache, whose attention is thus distracted, will give more thought to his tooth than to his job. An ingrown toe-nail is preventable; through neglect or improper treatment, it may cause lost time. Elementary hygiene, and the proverbial "stitch in time" must be observed if a man in industry, or out of it, is to maintain his health and efficiency.

While there are industrial health hazards, and while the zeal in discovering and eliminating them is commendable, the facts remain that the purely industrial diseases are very rare in the general industries; that preventable, non-industrial ailments are the preponderating cause of sickness disability and health impairment.

Interrelation of Sickness and Accident Disability

The daily contact with industrial disability, both sickness and accident, brings one in touch with their intimate interrelation. Septic absorption from such foci as teeth, tonsils, prostate, accessory nasal sinuses, peribronchial lymph-nodes, etc., causes much of the disability improperly labeled as injury; patients like to be told that their occupation does not suit them, that their work disagrees with them, but they may resent it if told that their teeth need repair, that their tonsils should be removed, that correcting lenses should be worn for their failing vision, or that arch supports are required.

This leads to the question of industrial fatigue. If a man works hard enough and long enough he will naturally get tired. Industrial fatigue may not be excessive, but the fatigue from other sources, combined with the industrial fatigue, may prove detrimental to an employee. For a man to be fair with himself and with his job, he must ascertain to what extent his job is tiring him out, and to what extent his fatigue arises from emotional causes (as domestic affairs, financial cares, worry, etc.); from septic absorption (as teeth, tonsils, prostate, etc.); from physical defects (as eye-strain, impaired hearing, flatfootedness, hernia, etc.); from latent diseases (as incipient tuberculosis, etc.); from acute infections (as grip, nasal catarrh, bronchitis, etc.); from improper diet; from unhygienic home conditions; from loss of sleep; and from other potent factors that may enter into the equation, in the accurate estimation of his total fatigue.

A worker who is constantly fatigued from any cause, or any combination of causes, will lose time now and then from sheer exhaustion. The fatigued worker is more susceptible to infectious diseases, from which he makes a retarded recovery; he becomes more stupid, and because less alert he more readily meets with accidental injury from which he recovers slowly, since he has impaired vitality, and we have injury plus sickness to deal with.

The Industrial Clinic

There being this interrelation of sickness and accident disability, constituting the twilight zone of sickness and injury, it naturally reverts to the industrial clinic to find out the sources of fatigue, to evaluate the factors that contribute to the fatigue total, and to facilitate the recovery of the individual, in the manner indicated by the findings of the inquiry. There arise specialties in industrial practice, when an industrial diagnostic clinic is organized; specialization is needed, employing diversified talent and training, such as required on a hospital staff. Beginnings of the industrial diagnostic clinic are observed at many places; among the specialties now covered are:

(1) Operative surgery, clean.

(2) Septic surgery; it is ill-advised to allow the doctor who treats boils, and infected wounds, to care for fresh injuries, or re-dress clean cases.

(3) Physical diagnosis — special reference to heart and lungs.

(4) X-ray service, developing into an ever larger field.

(5) Dental service.

(6) Pathologist, for sputum, urine, blood, Wassermann examinations, tissue staining, vaccines, etc.

(7) Oculist — injuries and diseases of the eye, and optical service.

In addition to these special lines of medical and surgical service, the works dispensary, as occasion demands, consults with orthopedic and general surgeons, internists,

alienists, neurologists, dermatologists, oculists, ear, nose, and throat specialists, endeavoring to establish correct diagnoses, and to co-operate in every legitimate way with the best available agencies for speedily restoring the disabled to health and to industry. Where the plant employs but few industrial physicians, group diagnoses, the collective findings of a diagnostic clinic, may be accessible elsewhere. The multiplication of such centers, within and without the industries, in the interest of health conservation, is much to be desired.

Community Health

The co-ordination of industrial and municipal health activities, as in Akron, Ohio, offers a solution of the problem of controlling epidemic diseases. With the community health problems solved, the industries will be spared the absenteeism from this cause, and the slackened production incident thereto. The works dispensary can become an out-station of the city Department of Health, with test tubes for throat cultures, so that suspicious throats may be swabbed when the patients are sent home, and no delay be encountered in getting reports on findings to attending physicians.

Social Service Work

The control of industrial health hazards is entirely up to the initiative of the industrial management. Health engineering experts — consulting physicians — specializing in the reduction of the health hazards are being employed by the industries, in conjunction with engineers in associated lines, to reduce these hazards.

Educational effort from within the industries strives to stimulate the initiative of employees into foresightedness along health lines. To what extent the industries can enter into community activities without becoming paternalistic is a debated question which we will not discuss. Model house-building enterprises — helping employees acquire their own homes — building and loan associations, banking, stores and restaurants on the no-profit basis, clubs, social centers, playgrounds, hotels for employees, industrial and technical schools, apprentice courses with technical schooling, athletics, bands, and glee clubs are among the forms of community enterprise fostered by many of the larger industries, and which have the endorsement and approval of employees.

The new spirit abroad recognizes participation in industry as in the nature of a social service; constructive good-will — based on mutual confidence and real justice — alone can operate effectively to solve the problems to which industry gives rise. In the trinity of production, Capital, Labor, and the Community must unselfishly co-ordinate their common functions of serving one another.

There are health hazards within the industries, that industrial initiative should control; within the communities, that the co-ordination of industrial and community health service can control; and within the scope of the individual, there are health hazards which require his personal initiative to combat successfully. With such co-ordinated efforts, the human dynamo will generate energy uninterruptedly; the worker, secure in the enjoyment of a fair share of the rewards of toil, can live to a ripe and honored old age.

SCOPE OF THE PHYSICAL EXAMINATION IN INDUSTRY*

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INDUSTRY exists solely for the purpose of converting raw materials into finished products of marketable value. Labor is employed in industry for the assistance it is in the accomplishment of that purpose, and its value is fixed by the skill and facility of its effort in that direction as manifested by the quality and quantity of its output.

Formerly, when labor was plentiful and the margin between the cost of production and a moderate selling price was sufficient to bring a reasonable profit, industry gave but little concern to labor. Workingmen came and went as they saw fit, were hired and fired as suited the fancy of their bosses, or were let out in dull seasons and taken on again when business improved. No well thought out attempt was made to offset unstabilizing influences and practically none to improve skill.

More recently, when labor has become relatively scarce and the cost of production higher, industry has been forced to realize that it has a problem in its labor relations; in fact, industry concedes this to be among the serious, if not the most serious, of its problems. Though old in existence, having been ignored, it is relatively new. Employers do not yet know how to solve this problem. They are groping. They have created welfare departments, employment, service and sociological departments, have sought to amuse, edify and pacify the working people, have divided profits with them and have appointed them to act on joint committees in the determination of policies — with little effect as indicated by the present unrest, the greatest the world has ever known.

Employers are still groping, and they are progressing. Labor turnover has been studied, absenteeism investigated, and the causes of spoilage and breakage sought. Information of value has been gained. It has been learned that the most capable and dependable workmen are those who are healthy, physically competent, and are assigned to tasks they like and know how to do rapidly and well. It has been learned that men, working under pleasant conditions void of undue fatigue and hazards to health and limb, are the best producers and consequently the best paid, are the most contented and valued of employees. Industry is now striving to procure such workmen; if unable to procure them in the usual way, to develop them; and, having them, to retain them by offering favorable working conditions and opportunities for further development and advancement.

The procurement of healthy, physically competent workmen may imply the rejection of those who are not so. However, it does not necessarily follow that such should be rejected outright and deprived of the privilege of gainful occupation. There are positions in industry, in fact in virtually every plant of reasonable size, that people of varying substandard conditions of health and body can fill with efficiency, to the profit of their employers and themselves. For example, defective eyesight may justly disqualify a man from operating a machine that requires acuity of vision, yet permit him to supervise a gang of laborers with competency. Again, a chronic bronchitis may render employment in a foundry hazardous and unprofitable, while in the open it may have no detrimental effect. Even the blind and the legless, the tubercular and the nephritic are capable of productive labor under proper conditions of employment. That only the manifestly unfit and the victims of communicable disease should be rejected, is a growing opinion among employment managers. The procurement of health and physical competency among working people requires that they be selected for and assigned to such jobs as they are or can be adapted to — with rejection a last resort.

The maintenance of a healthy, physically competent force of employees requires that working conditions shall be such as to safeguard health and limb, that workmen shall have knowledge of how best to live and labor in compliance with the laws of health and safety, and that health and limb shall be restored as promptly and effectively as possible after impairments or disease have

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occurred. The service of physicians, originally sought for the treatment of injured workers, has been found to be of use in the procurement and maintenance of healthy, physically competent working forces. Medical knowledge and skill are, therefore, welcome to industry, for anything that is capable of assistance in the stabilization and improvement of working forces is welcome. Because of this, medicine has come to be an important branch in the science of modern industrial management.

The physical examination is the means whereby physicians acquire the information they deem essential to the procurement and maintenance of healthy, physically competent working forces. It is, consequently, the basis of medical knowledge in industry and is fundamental to the successful practice of industrial medicine. The scope of the examination should be broad enough to enable physicians to gather the information that is requisite. This means it should uncover defects and diseases that render employment hazardous to him who seeks it or to his fellow workmen. It should uncover imperfections that contribute to inefficiency. It should uncover diseases and substandard conditions of health. In short, the examination should be such as to divulge the true condition; it should be fairly comprehensive.

Although a complete physical examination, with blood-pressure readings, urinalysis and other laboratory tests, is a desirable procedure to follow in industry, it is not always practical. In the first place, industry has not found it necessary except in unusual cases and, in the second place, industrial physicians are usually too pressed for time to investigate deeply. Experience has gradually evolved four grades of examination, depending upon the objective sought, which in turn is frequently fixed by the policy of the company immediately concerned. They are as follows:

1. *Superficial Inspection.* — This consists of a hasty survey for obvious defects and apparent sickness. It considers height, weight, appearance, deformities, distance vision, hearing, hernia, and occasionally the heart and lungs (stethoscope applied outside of shirt). Its objective is *rejection* of the evidently unfit and exclusion of communicable diseases.

2. *Inspection.* — This consists of a more complete survey. All parts of the body are exposed and their condition noted. Diagnostic instruments are used when in the opinion of the physician they are needed. This is practically an examination without urinalysis and other laboratory tests. Its objective is *selection and assignment* of workers.

3. *Examination.* — This consists of a reasonably complete survey of the body according to accepted methods, and includes blood-pressure readings and urinalysis. It is virtually the same as the examination required by life insurance companies. Its objective is not only the selection and assignment of workers, but their *health supervision* as well.

4. *Special Examination.* — This consists of all measures that are necessary to a thorough study of the body, including intra-ocular observations, gastric analysis, rectoscopy, cystoscopy, X-ray interpretations, investigations of the nervous system, blood counts, etc. Very few industrial physicians are prepared to make such elaborate and painstaking examinations. Individuals needing them are usually referred to consultants. The objective of the special examination is the *diagnosis* of obscure diseases and pathological conditions. It belongs rather to the realm of internal medicine than to industrial.

Inasmuch as by far the greatest number of occasions for investigation into the physical state of industrial workers occur when they seek employment, the inspection would appear to be the most useful of the four grades. It has the advantage of gaining enough information to enable physicians to eliminate the manifestly unfit, if desired, and to advise intelligently in the assignment of all others, and to do so with a minimum expenditure of time. Furthermore, it secures enough information for physicians to determine which individuals must have additional study, in the form of the examination or special examination, for the intelligent supervision of their health.

To exemplify the author's conception of the scope of examination or, more properly, the inspection, the routine in use at the Toledo plant of The National Malleable Castings Company is outlined as follows:

The worker is received fully clothed and remains standing until the feet are inspected. He is greeted in a friendly manner, and attempts are made to put him at ease if embarrassed or backward.

1. As he enters gait, carriage and appearance are observed.

2. He is weighed and measured for height.

3. Vision, both near and far, is tested.

4. The right ear and right side of head and neck are inspected. While this is being done the hearing on that side is estimated by a question in a low voice.

5. This procedure is repeated on the left side.

6. The face is inspected; the condition of the eyes is noted by lifting and depressing the lids; the nares, the mouth and teeth, then also the throat and the anterior surface of the neck are observed.

The worker is requested to remove all clothes from the waist up.

7. The chest is inspected and the condition of the heart and lungs estimated by percussion and auscultation.

8. The abdomen is inspected and the condition of the organs estimated by palpation and percussion.

9. The back is inspected and the posterior aspects of the lungs estimated by percussion and auscultation.

10. The spine is palpated and flexed.

The worker is requested to loosen his trousers and undergarments and let them fall down around the ankles.

11. The external genital organs and inguinal regions are inspected and palpated.

12. The sacro-iliac articulations are examined and the anal region inspected.

13. All extremities are inspected, mobility of joints and condition of blood vessels being especially observed.

The worker is now requested to draw up his underclothing and trousers, after which he is directed to sit down and take off his shoes and socks.

14. The ankles and feet are inspected. If there is any doubt about the arches, impressions are taken.

15. Blood-pressure readings are taken (optional).

16. A specimen of urine is obtained (optional).

The worker is now dismissed. During the inspection as defects appear, the physician is expected to inform the worker of their presence and to give him such advice as may seem wise, an interpreter being used when needed. Special features are emphasized immediately before departure and further advice given if necessary to enable the worker to do his work without hazard to health.

In commenting upon this procedure, it may be said that inspections by this method may be made superficial or thorough, as desired, with minimum expenditures of time and effort. The inspection moves easily, without offense, from the exposed parts of the body to those the blunt exposure of which may prove embarrassing to the worker. It meets the requirements for job placement, and prepares the way for subsequent examinations essential to the supervision of health. When accompanied by appropriate advice, when the information obtained is properly used in assignments to work, and when those found defective are afterwards helped through medical and social service and continued advice—then the inspection contributes to the health, earning power and peace of mind of the workers, and its scope may be regarded as being adequate.

In some establishments applicants for work enter the examining room stripped. If this can be done without offense, the physician's time may be thereby economized to the extent assumed in undressing and redressing. This is an advantage where large numbers are hired, but the tendency of physicians, speeding from one to another, is to slur the educational feature, which is of exceeding importance. On the contrary, if the doctor is forced to wait, he has the opportunity to discuss with the workers their conditions and has, therefore, no real excuse for not doing so.

That which has been said applies to the inspection of men. The inspection of women is quite another matter and, although the same general plan may be followed, considerable tact and discretion must be used. The thoroughness of the inspection must frequently be dictated by discretion, and it is wisdom always to have a female nurse present. Good judgment really indicates that women should be inspected by women physicians.

For the further exemplification of the author's conception of the scope of the inspection, a form which has been devised for recording the information is presented, as illustrated.* This form has been evolved from experience in the physical inspection of schoolchildren, the inspection and examination of applicants for employment and, during the war, from studies of industrial medical departments and the forms used in sixty-four of them. The form will not be described as, with the exception of the code at the top, it is self-explanatory. The code, it may be said parenthetically, is a part of a plan in use at the Toledo plant of The National Malleable Castings Company for determining the kind of operation for which an applicant for work is physically fitted; a description of this plan and an explanation of the code are not appropriate to this discussion. The principal advantages of the form are as follows:

1. It provides for specific mention of conditions most usually found, providing also for the recording of unusual conditions.

* One side only of this form is here reproduced. Diagrams of the human figure with numbered sections are printed on the reverse of the original form.

FORM 273

REPORT OF PHYSICAL EXAMINATION

THE NATIONAL MALLEABLE CASTINGS CO., TOLEDO, OHIO

DATE

CHECK No. NAME

AGE

FINDINGS:	A		B		C		1		2	3	4	5	6	7		8		9		10	
DATE OF EXAMINATIONS																					
CLASSIFICATION	R	L	R	L	R	L	R	L						R	L	R	L	R	L	R	L

EYES

11 Defective Vision
12 Old Injury
13 Conjunctivitis
14 Trachoma
15 Interstitial Keratitis
16

EARS

17 Wax in Ears
18 Otitis Media
19 Deafness from Other Causes
20

NOSE

21 Old Fracture
22 Obstruction
23

THROAT AND MOUTH

24 Pharyngitis
25 Enlarged Tonsils
26 New Growth
27 Syphilis
28

TEETH

29 Defective Teeth
30 Malocclusion
31

TONGUE

32 New Growth
33 Syphilis
34

NECK

35 Goitre
36 New Growth
37

LUNGS

38 Pulmonary T. B.
39 Pleurisy
40 Acute Bronchitis
41 Asthma
42 Emphysema
43

HEART

44 Valvular Disease
45 Myocarditis
46

ABDOMEN

47 Enlarged Liver
48 Enlarged Spleen
49 Chronic Appendicitis
50 Ventral Hernia
51 New Growths
52 Kidney Lesions
53
54

INGUINAL REGION

55 Inguinal Hernia
56 Inguinal Adenitis
57

GENITO-URINARY

58 Chancre
59 Varicocele
60 Hydrocele
61 Undescended Testicle
62 Epididymitis
63 Gonorrhea
64

EXTREMITIES

65 Old Fracture
66 Old Mutilation
67 Varicose Veins
68 Ankylosed Digits
69 Other Ankylosed Joints
70 Wrist Deformities
71 Flat Foot
72 Bunion
73 Ingrowing Toe Nails
74

ARTERIES

75 Arterio Sclerosis
76 Aneurism
77

BLOOD PRESSURE

78 Systolic
79 Diastolic
80

SKIN

81 Acne
82 Eczema
83 Psoriasis
84 New Growth
85 Syphilis
86 Other Infectious Diseases
87 Scars or Identification Marks
88

GENERAL

89 Weight in Pounds
90 Height
91 General Appearance
92

URINALYSIS

93 Sugar
94 Albumin
95 Sp. G.

MISCELLANEOUS

96
97
98
99

NOTE:—MARK √ TO INDICATE DEFECTS THAT DO NOT REQUIRE MEDICAL MEASURES. X THAT REQUIRE MEDICAL MEASURES BUT DO NOT DISQUALIFY. * THAT DISQUALIFY. DESCRIBE X AND * ON OTHER SIDE, USING REFERENCE NUMBERS AND DIAGRAMS WHERE NECESSARY.

2. It records findings practically in the order of inspection and indicates at a glance the side of the body involved.

3. It permits recording with a minimum of clerical effort.

4. It permits tabulations and compilation of reports with a minimum of medical knowledge and clerical effort.

5. It permits diagrammatic representations of abnormalities and amplified descriptions of special features.

6. It permits the recording of three subsequent inspections in direct comparison with the original.

7. It has a wide range of adaptability in the recording of information secured by means of any of the various grades of examination, except the special examination.

In the use of this form, the physician may himself register his observations or, better, he may memorize the numbers and indicate to his clerk the findings by their number. The latter method is of course quicker and easier for the doctor.

It will be said in closing that neither the procedure for physical inspection, as outlined, nor the form is regarded as final or conclusive or in any sense a finished product. Minor changes and additions are constantly being made in both, as experience indicates their need. They have been presented here to-day primarily for the purpose of exemplifying the author's conception of the scope of the physical examination in industry. It is hoped, however, that their presentation may stimulate this organization to take further steps toward the standardization of the examination and the form, and a promulgation of a better conception of the relation of the examination to industrial medicine and of that to the needs of industry and labor.

INDUSTRIAL DERMATOSES, THEIR SOURCES, TYPES AND CONTROL*

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THERE are two sorts of factors that act in the production of industrial, as well as of other skin diseases: The first are the individual or predisposing factors; the second, the specific exciting causes. It may clear the ground and save time if, before taking up the exciting causes, which are our chief concern, we consider for a moment the first group, the personal predisposing causes.

Predisposing Causes

The predisposing causes are the factors in the personal equation which make the skin of varying resistance in different individuals; and these factors are many:

The protection afforded by the skin varies greatly in different individuals and under different conditions. The youthful skin is more delicate than that of the adult. The skin also has senile changes, which may occur prematurely without reference to other senile changes, that lower its resistance. The woman's skin approximates the youthful skin and is more sensitive than the man's skin.

Local conditions in the skin as, for example, vascular disturbances, may weaken its resistance; the skin in which the circulation is poor is of increased vulnerability. The skin which normally sweats profusely is more resistant to some external irritating influences than the dryer skin but is more vulnerable to other external injurious influences. Previous injuries to the skin as, for example, many reactions from external irritants, may permanently damage its protective quality. The greasy skin of the negro, Mexican, and Indian is tough and can endure exposure to many insults that damage the white skin. Individuals show even greater variation. At one extreme we have the normally tough skin, the resistance of which is remarkable; at the other, we find the individual whose skin is so sensitive that blisters and ulcers are produced by slight blows and pressures, which are harmless to the normal individual.

We also have variable personal susceptibility to irritants. What is one's skin poison may be harmless to another. Everyone knows that poison ivy, for example, is not poison at all to many persons, while in others it produces an inflammation of the skin of extremest severity. We see manifestations of this personal susceptibility to particular irritants constantly in industrial dermatoses. Often, after repeated exposure, the skin will acquire resistance to an irritant. Unfortunately, also, it may become sensitized after repeated exposure, so that we not infrequently see persons suffering from inflammation of the skin from irritants which formerly were harmless to them. These factors of varying susceptibility come constantly into play in industrial dermatoses; and they must be borne in mind as an essential part of the problem whenever we are considering the exciting causes of such conditions.

Exciting Causes

The exciting causes of industrial dermatoses are beyond exact enumeration. These causes, however, may be classified into a few groups, and by briefly considering these we may obtain, perhaps, a suggestive orientation of the subject. More than the briefest consideration of these various groups is impossible within the time of this paper.

The exciting factors of industrial skin diseases may be included in the following classes: (1) heat; (2) cold; (3) weather; (4) posture, friction, pressure; (5) parasites; (6) infections; (7) mechanical and chemical irritants.

Heat

Except as it produces scalds and burns, which are in most cases surgical injuries involving more than the skin, the direct action of heat is not a common cause of

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trade dermatoses. Radiant heat may irritate the skin to the point of producing inflammation — dermatitis — either chronic or acute; we see this, for example, in the form of an eczema of the forearms and face in bakers. Occasionally, after long habitual exposure, heat may produce structural changes in the skin, shown by pigmentation, dilation of the capillary blood vessels and thinning of the skin — a condition that sometimes occurs in stokers whose legs are especially exposed to the effects of heat. Rarely, it excites one of the uncommon skin diseases, such as lupus erythematosus. But on the whole, the dermatoses resulting directly from habitual exposure to heat of endurable intensity are surprisingly few.

On the other hand, the indirect action of heat in producing sweating is a frequent cause of skin disease. The skin sodden with sweat is a vulnerable skin. It chafes and develops eczema; and in it trivial diseases, such as mild seborrheic eczema, become exaggerated into troublesome ones. A habitually sweaty skin is also a favorable soil for bacteria, and infections frequently occur. Pus infections are commonest, resulting in boils, forms of purulent infections of the skin, and certain types of eczema. Other sorts of infections are also not infrequent, particularly forms of ringworm of the crotch and of the hands and feet, which at times become disabling.

It is very difficult to counteract the damaging effects of radiant heat on susceptible skins. Some protection is afforded by covering the skin to protect it from direct radiation, and more can be done by interposing an impervious screen between the worker and the source of heat where this is possible. The bad effects of habitual continuous sweating can be minimized by frequent bathing and other measures to promote cleanliness and by intelligent attention to beginning skin diseases, particularly to beginning infections. The bad effects of sweating are shown chiefly on the hands and feet and in the deep folds of the body. Much can be done to control trouble in these locations by intelligent medical care.

Cold

Prolonged exposure to cold is apt to damage the skin by producing permanent damage to its vascular structures. These permanent changes occur chiefly in terminal areas of circulation, such as the ears and nose, and especially the hands and feet. Everyone is familiar with these manifestations as chilblains, but not so familiar is the condition of chronic passive congestion of the extremities that shows as cold, clammy, purplish hands and feet and is very common in outdoor laborers in rigorous winter climates. It is the same condition as chilblains, but in a lesser degree. It greatly lowers the resistance of the skin and is a frequent predisposing cause of trouble. This condition and chilblains are of so common occurrence that they constitute occupational dermatoses of considerable practical importance.

The early experience of the great war with so-called trench-foot — which is chilblains — has shown that there are several factors in the production of this condition: first, prolonged or habitual exposure to cold, especially if the extremities are covered by wet gloves or shoes which cause rapid loss of heat by conduction; second, hardship in the sense of over-fatigue and failure to get proper food, including at least one hot meal a day; third, the wearing of clothes which by constriction interfere with the return circulation, such as tight shoes or tight gloves. In passing, it may be said that the wearing of puttees which shrink when they get wet and then bind the legs was found to be particularly bad in this respect.

The application of these facts to the prevention of the bad effects of cold of the skin in industry are obvious.

Weather

It may seem to be going far afield to refer to industrial dermatoses that are due to exposure to the weather; but they are a real occurrence. You are familiar with the weather-beaten skin of old sailors and farmers and others whose occupations have kept them exposed to wind and sun and cold for years. The skin is wrinkled and ruddy and rough. In those more susceptible to these influences, the cumulative effects of many years of exposure produce serious degenerative changes. They are results of wear and tear and they cannot be guarded against; but they are truly the result of occupation. Fortunately the skin cancers that result in these cases can usually be easily cured if recognized early.

Posture and the Effects of Friction and Pressure

The familiar calluses and corns and thickening of the hands in workers which occasionally produce disability can only be referred to. More important are the vascular disturbances of the legs which may result from habitual standing and which are a common source of skin troubles. These troubles are due to varicose veins. Varicose veins, and the passive congestion of the skin of the legs which the condition entails, sooner or later lead, almost invariably, to more or less dermatitis of the legs and not infrequently to ulcers. There are some uncommon dermatoses which are occasionally excited by standing; but these are so rare as to be of little practical importance in comparison with the very great practical importance of dermatitis and ulcer in the skin caused by hypostatic congestion.

Varicose veins cannot be guarded against. They may be the result of inherently poor vessels (our blood vessels are very much like rubber tubing and they vary in quality in different individuals); more frequently they are the sequel of disease. Men with varicose veins cannot make efficient workers in standing jobs and should avoid them. They do better in jobs that require a reasonable amount of walking; but they are not good workers even for these jobs. Varicose veins are common in women as a result of child-bearing. Women with this condition are likely to suffer eventually from its effect on the legs and should avoid standing jobs.

Parasites

The damages of parasites to the skin occur in those occupations which involve the collection of groups of men in intimate association, as in work trains and labor camps. Under these conditions, the ravages of vermin are almost inevitable. Fleas, bedbugs, lice and itch are more than an annoyance; they lead to infections of the skin that produce disability to an important extent. For example, in the allied armies on the western front, under conditions of heavy warfare, where measures to control the pests could not be applied, the ravages of itch and lice and the secondary pus infections which followed them, produced more disability than any other form of disease. Practical measures for the control of vermin are well known and they should be applied to their extermination in industrial camps.

The causes to which we have referred above, while they produce a very considerable quota of industrial dermatoses, are relatively unimportant in comparison with the two great causes we have yet to consider — infections and external irritants.

Infections

In the practical consideration of infections of the skin, we will leave out of consideration as one of the factors in their occurrence lowered individual resistance, although this is a factor of importance in infections of the skin, as in infections of other tissues. For infections of the skin to occur, there are at least two essential conditions:

(a) A break in the skin surface through which organisms can find entrance.

(b) The presence of pathogenic organisms.

For all practical purposes, it may be said that an infection cannot occur without a break in the skin. Infections, therefore, occur most frequently in rough occupations because in these injuries to the skin are constantly produced.

Bacteria and other microscopic organisms require for their growth organic matter, either vegetable or animal. Infections, therefore, are most frequent in those whose occupations expose them to more than ordinary contact with organic matter. Pus organisms are everywhere and pus infections occur in all men; but even infections of this sort are much more frequent among those whose occupations are, speaking bacteriologically, dirty. Although pus infections are far and away the most frequent of disabling dermatoses, there is a formidable list of other infections of the skin which occur in industry. These specific infections occur pre-eminently in persons whose occupations bring them in intimate contact with organic matter, whether live or dead, such as manure, soil, grasses and moulds, live and dead animals, furs, hides and hair, meats and fish. These bacteriologically dirty occupations furnish almost exclusively a large group of troublesome and often dangerous specific infections of the skin.

To guard against these specific infections in practice is an exceedingly hard problem. It is the more difficult because these infections are often sporadic and of infrequent occurrence, although in the aggregate they cause a large toll of disability and death. The two essentials in reducing infections are to maintain an unbroken skin, as far as possible, and to prevent infection when breaks occur. It is a matter of practical importance for workers to guard against slight wounds of the skin and, when they do occur, to take proper care of them. Superficial breaks in the skin which are not infected, should be sealed to prevent infection. This can be done by covering them with flexible collodion or with clean adhesive plaster or by a clean bandage. Before sealing them, they should be disinfected.

The industrial custom, now common, of having all wounds disinfected with tincture of iodine might be very well extended to encouraging the use of tincture of iodine in disinfecting all small breaks in the skin. It would be an equally useful measure, I believe, to encourage in workers the custom of protecting, either by sealing or by some dressing, minute breaks in the skin, particularly about the hands. Flexible collodion is as practicable to keep accessible and to apply to the surface as is tincture of iodine; and if the custom were fostered among workers of sealing with collodion minute breaks in the skin, the result would be almost as important as that which has followed the habitual use of tincture of iodine to disinfect immediately trivial wounds. There is one caution that must be used, however, in sealing wounds. Penetrating wounds—that is, wounds going beneath the skin—should not be sealed, particularly wounds from objects which have been in contact with the soil, because of the danger of lockjaw and of other serious infections which occur especially in soil and grow freely only when excluded from contact with the air.

External Irritants

A list of the irritants that produce industrial dermatoses would include practically all known local irritants. Such irritants may be mechanical or chemical.

The *mechanical* irritants are relatively few, but purely mechanical irritants may produce dermatitis as, for example, occurs from prickly or thorny non-poisonous plants or their fruits, and from the siliceous spiny particles in sponges. The origin of such inflammations of the skin may be quite unexpected and difficult to determine, as is illustrated by a baffling epidemic of dermatitis which occurred among stevedores in Bristol, England, and which Wills finally demonstrated to be due to fine vegetable prickles on barley barbs.

But by far the greatest number of irritants that affect the skin are *chemical* irritants. These may be animal irritants, such as poisonous hairs of some caterpillar; or vegetable irritants, such as poison ivy or sumach, or primrose and other poisonous plants; or lacquers; or the dust of irritant woods, as teak-wood. The list of such irritants is long and of practical importance. The chemical irritants, using this term in its ordinary sense, range from the oldest known substances used in industry, such as salt, soap and soda, to the newest, such as T.N.T. and mustard gas. Even to enumerate those better known would make a list covering pages. We see their effects in all grades of occupations from the humblest to the most technical. The damage they do usually expresses itself as a dermatitis—an inflammation of the skin—of greater or less severity. In its slightest degrees it may be only a pinkness or redness of the skin with some itching or burning. It may in other cases be a violent inflammatory process with blistering, swelling and secondary systemic symptoms. In extent, the eruption may affect only a small part of the body surface, or it may be universal. The severe chemical irritants, such as the strong acids and alkalis, may produce complete destruction of the skin with the formation of extensive wounds or ulcers.

In addition to the irritants that produce the usual inflammatory reactions, there are certain industrial substances that produce lesions in the skin which are not of the ordinary inflammatory type. The substances which do this especially are tar, mineral oils and greases and their derivatives, and, perhaps, true fats. The commonest lesions which these substances produce are boils and large crops of blackheads and pustules. Such eruptions are seen not infrequently in men habitually exposed to these substances in their occupations. It is a very interesting fact that similar substances are well-determined causes of skin cancer in workers. Chimney-sweepers' cancer, from irritation of soot, has long been recognized. More

recently, it has been shown that similar industrial cancers may be produced by pitch, tar, paraffin, creosote oils and other coal and petroleum distillates.

The control of industrial dermatoses manifestly presents a great many special problems which vary with the numerous irritants that are involved and with the conditions of their use. Under certain circumstances, practicable measures are available to neutralize the irritants, either before or after they come in contact with the skin. Under certain conditions, it is possible to prevent their effects by the wearing of protective appliances such as ordinary gloves, or rubber gloves, or gloves treated with shellac or other substances to make them impervious. In the manufacture of T.N.T., varnish of orange shellac, which is painted over the hands, forearms and other exposed surfaces, is said to furnish effective protection, and is suggestive of similar protective varnishes that might be devised for use in other irritating occupations. But, of course, the only entirely satisfactory protection against industrial dermatoses from external irritants consists in preventing such irritants from coming in contact with the workers. This may be practicable, or it may be impracticable or impossible. It is sometimes found to be practicable under necessity, where before it was held impossible.

The most practicable way of handling the problem in certain industries is by the selection of workers who can endure, without damage to the skin, the amount of external irritants which are necessarily involved in the occupation. Some men cannot work at all where others can work without damage. My impression is that nothing is gained by trying to keep these susceptible men at work which produces skin trouble. The best thing is for such men to shift their occupation, if possible, when the inability to endure the irritants involved is discovered. When old workers acquire a susceptibility, shifting of occupation may cause heavy sacrifices which they desire to escape. In such cases, unusual precautions and medical care may enable them to continue. But it is usually only at the expense of discomfort and periods of disability.

I am acutely conscious of the altogether general character of this consideration of the subject. My only hope is that it may at least suggest the extent and possibly the importance of the problem. I think these two facts are not generally appreciated. Industrial medicine is so largely concerned with surgical injuries and serious diseases that it has little time to devote to troubles of less gravity. And yet, I believe that the aggregate of distress and disability resulting from such minor troubles as industrial dermatoses is so large that it is a matter of great practical importance and worthy of intensive study. It is unfortunately a matter which has not been given systematic study by experts in skin diseases, either in this country or abroad, with the possible exception of Germany. It is, of course, a matter of thoughtful consideration to every conscientious industrial physician, and of sporadic study by expert dermatologists, when circumstances bring such cases within their experience. The experts in industrial medicine are unfortunately not experienced in dermatology, which is a highly technical specialty.

There is an important field here which is worthy of systematic investigation and which promises important practical results. I believe it would be highly useful if a systematic investigation of this subject by experts were undertaken in this country. One practical way of undertaking it would be as follows:

Employ a few men, who are trained dermatologists, to devote all of their time to an investigation of industrial dermatoses as they occur in our centers. Competent, younger men of this sort could be found, who would be willing to undertake it. Associate with these full-time investigators a consulting board of mature experts in skin diseases who would be available for consultation and advice and for special investigations. Such men are to be found in our large cities and are in practical contact with nearly all industrial centers.

I believe a well-directed investigation of industrial dermatoses continuing for a considerable time, perhaps two or three years, would result in an important addition to our knowledge of this subject — not so much to our knowledge of the diseases, because they are pretty fully and accurately known, but of the factors which are important in the production of these diseases and in their prevention and control. It was found possible to do work along these lines in the handling of very complicated problems of disease that threatened our army

during its mobilization in this country; and I believe such a system could be effectively carried out in studying this problem in industrial life. It could not be so effectively pursued, even by thorough co-operation, by experts who are all in fixed locations. It requires a certain number of them to be mobile so that their services may be used anywhere. I avail myself of the opportunity which this occasion affords to call attention to this matter as one worthy of being fostered.

THE TREATMENT OF BURNS*

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MOORHEAD, in his *Traumatic Surgery* (1), published in 1917, writing of burns says: "Practically speaking, they should all be regarded and treated as infected wounds due to heat." Colcord (2) in a most careful discussion of burns and their treatment says of a visit to a hospital where there were many burned cases: "Every burned surface was covered with pus and the smell was disgusting. Many writers speak of the absorption of pus from suppurating burns as a frequent cause of death."

Why is it that burns tend to run a septic course? The heat which is sufficient to kill the cells of the skin layers in a third degree burn should certainly be strong enough to destroy microörganisms upon this skin and it undoubtedly does. Thus a burn is an injury to one or more layers of the skin resulting in death of the exposed tissues and readily infected either direct from without or from the neighboring unburned skin. Therefore, if we can keep a burn sterile it should, after the separation of the slough, become a clean granulating wound and follow the same course as other wounds of this type.

While epithelium will grow on an infected surface, its growth is slow and unsatisfactory as compared with its growth over a sterile surface. It is exceedingly difficult to maintain sterility in a burn of any magnitude. Even with the greatest care any wound which is frequently dressed becomes infected and this is particularly likely to occur when a mass of dead and partially devitalized tissue is the type being treated.

In considering the treatment of a burn we have to consider two things, the treatment of the burned individual and the treatment of the local condition, the part burned.

The treatment first should be directly for the burned individual. The conditions to be combated are shock and nephritis. Secondary conditions such as fever and pulse rise with meningeal symptoms, vomiting and diarrhea, and sometimes symptoms of gastric or duodenal ulcer may appear as a result of thrombosis and toxic absorption from the local burned area. These must be met as they arise.

The order of treatment is as follows:

1. Put the patient to bed in a warm room with hot water bags to feet.
2. In removing the clothes, cut around burned areas being careful not to tear the clothes from the skin and cause additional trauma and avenues for infection.
3. Protect the burned areas thus exposed by covering with sterile towels or sheets.
4. Give patient $\frac{1}{4}$ gr. morphine with $\frac{1}{100}$ gr. atrophine by hypodermic. Repeat with caution if necessary. Morphine is a stimulating narcotic and if used carefully can be employed to combat the shock without risk.
5. As soon as possible, start a Murphy drip in order to combat shock and supply fluids to the kidneys.
6. When patient's condition begins to improve, start treatment of the local burned area.

The local treatment of a burn is practically the same for first degree, second degree, and third degree burns. One or all types may occur in any case. The first degree burn involves only the outer layer of the skin, there are no blebs following and no scarring results. The first, last, and only treatment needed in this type of burn is to powder freely with powdered stearate of zinc. When this type merges into second or third degree burns in the neighborhood, the whole area had best be treated with a solution dressing. Before this is applied,

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however, a careful cleansing of the skin with a mild antiseptic is carried out. This must be done thoroughly, but gently, especially around the burned areas. For the skin three or four inches from the burn, benzene applied with cotton mops and followed by $3\frac{1}{2}$ per cent. tincture of iodine is probably the most satisfactory method of sterilization. As we approach the burn, ether should be substituted as it is less irritating. It is applied with cotton mops. The doctor should wear sterile gloves, use sterile instruments, and if he opens blebs should first sterilize the area with $3\frac{1}{2}$ per cent. tincture of iodine. Moorhead recommends puncturing the bleb aseptically at the junction between the sound and unsound skin.

After the surrounding skin has been prepared and the blebs attended to, the burned area should be covered with a suitable sterile dressing. There are three types of dressing now in use.

1. Wet solutions, of which the most favored are 1 per cent. solution of picric acid and saturated solution of bicarbonate of soda.

2. Ointments, of which the most used are boric acid and soda bicarbonate, 3 per cent. There have been a number of special burn ointments developed, two of which have been so thoroughly tried out that their formulæ will be given.

First Ointment. Used by Dr. A. W. Colcord in the treatment of 8,000 burns.

℞
Carbolic Acid
Thymol
Menthol
Camphor of each gr. 5
Ichthyol
Balsam of Peru of each gr. 10
Zinc Oxide
Starch of each $1\frac{1}{2}$ drachms
Petrolatum to make one ounce. Mix well.

Dr. Colcord uses this ointment in 1/6 strength from the start, applied daily with aseptic precautions.

Second Ointment. Used at La Panne, Belgium (3), during the war.

℞

Vaseline	20	
Lanoline	20	
Antipyrine		60
Boric Acid		60
Salol		20
Iodol or Iodoform		20
Phenol		20
Bichloride of Mercury		02

This ointment gave extremely good results and was used with aseptic caution.

3. The third type of primary dressing is warm wax. This method started with the proprietary substance, ambrine, but it has been found that the action is only mechanical so that there are a number of mixtures of paraffin and resin now on the market which are quite satisfactory. One used at the American Steel and Wire Company and at the Norton Company at Worcester consists of

Paraffin	70
White Wax	20
Resin	10

All of the combinations are dispensed in solid form and must be melted before using.

The method of applying the wax is first to dry the skin thoroughly, using an electric blower such as is used in barber shops for drying the hair. After the area to be treated is thoroughly dried, the wax is either sprayed or painted on. Spraying is wholly painless, painting nearly so. The wax must be just liquid before being applied and can best be melted down in a double boiler. When the wax is painted on, sterile cotton swabs on applicators are the best instruments to use. The warm liquid wax should be dabbed on, not "painted." The wax hardens almost at once, forming a smooth coating extending over the sound skin for a short distance on all sides of the burned area. Upon this thin hardening wax layer, sterile sheet wadding which has been dipped in the wax is laid and over this another layer of sheet wadding. The whole dressing is held in place by a bandage. The advantage of using wax is the immediate covering of the burned area with a smooth sterile protecting surface with splinting of the injured part. The wax is removed daily, coming off *en bloc* with the sheet wadding. The secretions underlying it are washed off with normal saline, the area dried with hot air, and a fresh wax dressing applied.

It seems to make little difference which method is used if the work is done carefully and absolute aseptic technique maintained throughout. Personally, the author prefers a sterile saturated solution of soda bicarbonate for the first few dressings. It is easy to apply, gives considerable relief to the patient and requires less technique and handling of the injured area than the oint-

ment or wax. It should be applied by saturating a piece of old sterile sheeting in the solution and wrapping this loosely about the burned area. The moisture is maintained by surrounding the wet linen with oiled silk. The dressing can be moistened from time to time by lifting a corner of the silk and carefully adding the solution.

If there is little sloughing, the ointment or wax treatment can be instituted but if much sloughing is present a moist dressing will be needed. The disadvantage of continuing the soda is that if any infection is present it is liable to flourish in the alkaline medium unless the medium is distinctly antiseptic. For this reason it is well to stop the soda dressing after twenty-four hours and use alum acetate solution.

R

Alum	pts.	5
Lead Acetate	pts.	25
Water	pts.	500

Dissolve separately and mix.
Do not filter.
Shake before using.

This solution is mild, non-irritating and antiseptic. It has a white precipitate which seems to have a very soothing effect upon the skin. The solution has been used largely at the Worcester City Hospital and elsewhere for burns.

After the slough has separated and granulations begun, the burn may be considered a granulating wound. Three things must now be considered, encouragement of epitheliation, care of the granulations, prevention of a deforming scar.

Epithelium forms from the germinal layer of the skin and its down pocketings, and it is from this layer that fresh epithelium is formed. Three things seem to assist epitheliation greatly: first, a sterile granulation tissue to grow over; second, a smooth surface to grow under; third, pressure.

The difficulty of preserving sterile granulation tissue has been mentioned. If it can be preserved, wax provides probably the best type of surface to grow under. Its chief advantage is the ease with which it can be removed without injury to the new-formed epithelial cells. At the Ambrine Hospital in Paris a thin layer of sterile zinc oxid ointment is applied along the epithelial edge further to protect the cells, especially when the hot wax is applied. The cleansing of the wound after the removal of the wax is easy as compared with the cleansing of a wound covered with ointment. However, where there is any tendency to infection of the granulating surface the ointment is probably somewhat preferable because of its antiseptic properties. The importance of pressure in the healing of granulating wounds was first noted by the author when examining a series of burns in the Worcester City Hospital. Burns of the back were in all cases progressing better than burns of the chest or extremity, and it was concluded that pressure was an accelerating factor. It seems to make little difference as to the type of covering which is employed provided it is smooth. Thus sterile adhesive plaster has been used by many, and the author has obtained good results with gutta percha tissue, if there are no wrinkles or air spaces.

Granulation tissue once infected is almost impossible to sterilize, as those who worked in France know only too well. Therefore, the basic principle in the treatment of burns as in all surgery is to keep asepsis of the wound if possible, and, if in spite of all care it becomes septic, endeavor in every way to render it again aseptic. In burns involving a large area, the burned area always becomes infected. This has been strikingly brought out by Fauntleroy and Hoagland in their recent paper in the *Annals of Surgery* (4). In cases of this type it is obviously impossible to expect to obtain sterility. The method used in treating these very extensive and difficult burns, employed by these authors and also favored by Moorhead, is the open-air treatment without any dressing at all. Massive crusts form over the burned areas and beneath these pus forms plentifully. Cases seem to do a little better if the crusts are not removed, but gently lifted when absolutely necessary to give drainage.

The crust forms a dressing very similar to paraffin. Fauntleroy and Hoagland in discussing the treatment of these crusts say, "There seemed to be two separate, distinct periods, at which time two distinct results occurred simultaneously in all cases. The first period in which removal was continuously followed by the same heaping up process. The second period in which following a week's period of non-interference, removal at this juncture of the crust with the application of a thin smear of boric ointment on lint was followed by a quick bridging over of the raw surface with new

skin and complete healing with no scar formation in a few days' time."

To sum up: While it should be possible to maintain sterility in burns, this is difficult and, where large areas are involved, almost impossible.

In treatment the individual should be treated first, the burn, second.

The treatment of the burned area may be divided into the primary treatment which consists of cleansing and the application of a moist dressing, and the secondary or more permanent treatment when open air, special ointments, solutions, or wax may be indicated.

Experience tends to show that absolute standardization of treatment is impossible in the secondary treatment as burns react in different ways. It would be advisable, however, to restrict the drugs and ointments to a minimum number and study each one carefully in order that a certain type of standardization may be obtained.

Emphasis should always be laid upon strict aseptic technique without which good results cannot be obtained.

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INDUSTRIAL CLINICS IN GENERAL HOSPITALS*

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CLINICS in industrial plants for the immediate care of injuries and medical ailments have become of undisputed value and laws are even being passed to require them. They need no argument now with those of open and educated mind and I have no need to discuss them as they are outside my personal field. The character and extent of the service that they will render may ultimately go far beyond what is now done in most plants, though this is of course a very debatable question since it is by no means certainly desirable, and because it conflicts with the established interests of medical practitioners. But however far this may progress, general hospitals will for an indefinite time to come, if not always, be the centers for groups of experts in the various clinical and laboratory lines that are now essential in the diagnosis and treatment of patients and in the study of problems of health. Individual industrial establishments can scarcely be conceived of as having, each within its own employ, a group of leading men in all the various lines of clinical and scientific medicine. Hospitals, particularly those connected with medical schools and with the staffs that the latter have, will always, therefore, need to be centers for the study and treatment of difficult cases and for the investigation of problems, however far health establishments in industrial plants may progress.

At the present time, however, the general hospitals receive and they will long continue to receive not only complex cases but the every-day routine sort of case for ordinary diagnosis and treatment, and they have in their clientele, all told, a greater number of industrial workers than any other organized establishments for the care of the sick. In performing their simple daily round of duty then, as well as in acting as consultation centers, the hospitals cannot give proper service unless they have on their staffs persons familiar with industrial hazards and their results, who will be alert to recognize these and capable of determining their importance or insignificance in individual cases. Let us contrast this matter with others that are comparable. No hospital is capable of giving what is now recognized as good diagnostic or therapeutic service to patients with infectious diseases, for example, unless it has available the men and the equipment for expert bacteriological work, any more than it could give good surgical care without surgical equipment and expert surgeons. Although not a separate science like bacteriology but a work based upon various sciences, the study and recognition of the hazards of industry and their effects is a clear-cut and well-defined type of work. Its problems are quite as definite as those of bacteriology and, while they are even more varied and complex, the nature of many of them and the method of attack upon them are clearer and, in expert hands, more likely to be successful.

The possibility of an industrial origin of health disturbances and the need of determining this point comes up, too, in the great bulk of the hospital clientele; in fact, its possible importance needs to be considered in a far larger number of cases than does any other health factor. In the first year that our industrial clinic at the Massachusetts General Hospital was so organized that it received the greater part, at least, of those patients who might be suffering from effects of industry and in whom this needed to be determined with care and through trained and intelligent inquiry, over 5100 persons were sent to this clinic for investigation; of this number, approximately one-tenth showed actual results of their work of dominating importance in explaining their ill health. In most of these instances the question could not have been settled, and in those in which there was a relation the relation would have been overlooked, had the investigation been done in the customary way by persons who had not accumulated interest in and extensive knowledge of the possible relations of the patient's job to his illness. This is clearly shown in our experience in that time in lead poisoning. A special search was made for lead poisoning in all persons in whom care-

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ful inquiry showed any exposure to lead. Ordinarily the poisoning is looked for only when either the hazard is obvious and commonly known or when the symptoms clearly suggest it. The difference in method had the result that the same number of lead cases were found in one year by special search as were diagnosed in five years by the ordinary methods, and this in the same clientele coming from the same general line of industries.

A considerable trial of a special industrial clinic in a general hospital and of other well-defined methods of attacking the problem of the relation of industry to general medicine has convinced me that no other method than a special clinic goes so far to insure good service to the patients, and no other method so stimulates and enlightens the interest of the hospital staff in general in this important health factor. Likewise, by no other means is it possible to group the cases together in such manner that the results of study can be analyzed and made available, and in no other way does there occur such an accumulation and repetition of experience as to make evident important problems that had been unrecognized or had seemed of little significance.

To be really useful and successful several things appear to be necessary. The clinic should be in charge of a physician whose greatest interest is in the work, and he should be on sufficient salary to enable him to spend most or all of his time at the work. This is necessary in order that he may properly develop his clinic and may be free to make many visits to factories, in order to accumulate constantly increasing knowledge of industrial processes, and in order to determine day by day whether in doubtful cases seen in the clinic the work really explains a part or the whole of the effect upon health. Much of his time will be needed also in making studies in the clinic, in factories and in the laboratory, of the problems that are frequently suggested, and in this he will have many opportunities to keep occupied voluntary or paid assistants. Another essential element in the clinic's success will be a trained social worker who is familiar with factory conditions and industrial processes as well as with general social conditions. Through her will be best handled many of the social details of the records, and she will be able to investigate both home conditions and factory conditions in order to provide the essential knowledge of the relative bearing of the home and the factory upon the health of the patients. Such a small, paid staff is necessary for success. From this it may easily be enlarged with voluntary or paid workers as occasion demands.

Furthermore, a method must be adopted which will make sure that all cases with interesting or suggestive industrial relations get to the clinic. It will not suffice to depend upon workers in the medical, surgical or other clinics for sufficient interest to refer cases either spontaneously or upon request. They usually do not recognize the hazard or its relation to the patient, and in the pressure of their own work they frequently forget to send any that they do recognize. We have, with some success, adopted the plan of having a social worker, who is sufficiently instructed in industrial hazards to serve in this way, stamp the cards of all new patients as they enter, if their occupations come within a list furnished her or if they otherwise seem interesting. Whatever other clinics they go to, patients must, when so designated, go also to the industrial clinic before leaving. The other social workers in the various clinics are also instructed to send to the industrial clinic any cases showing points of interest in relation to industry. Cases that are primarily of industrial interest, especially certain groups that are being particularly studied in the industrial clinic, are transferred to that clinic for regular care; others are simply referred for diagnostic, therapeutic or preventive advice while their management is continued in the other clinics.

Carried out consistently in this way, the clinic will, in any large out-patient department, have abundance of material both to provide wide experience in industrial effects upon health and also for study of the problems that local industrial activities furnish. Some of these problems will be already known; some will become apparent from time to time as a large number of people pass through the clinic and the possible relation of a job to a disorder becomes emphasized by repeatedly meeting the possibility.

The primary value of such a clinic has been, in my mind, the better care of the patients. Equally obvious are the opportunities for furnishing new knowledge, and thus improving conditions through care-

fully planned studies and through accumulation of records and analysis of these.

Likewise important to a hospital that has relations with a medical school, is the opportunity to train all students into an appreciation of the relations between varied industries and medicine and to give special and detailed training to undergraduates or graduates who wish to become especially qualified in the medical service of industry. The latter students can be given thorough knowledge of a limited number of hazards through serving temporarily in one or more plants. In no other way, however, than in such a clinic, so far as I know, can students so well be given a comprehension of the extremely numerous and varied hazards they should be prepared for, and then have opportunity to observe in factories a considerable number of types of these hazards and the methods of controlling them. By serving with the staff in an industrial clinic and in the factory visits to which the work in the clinic leads the staff, students get a wide general training in elementary knowledge of industrial hazards, which would otherwise be obtained only slowly, laboriously and unsystematically.

In addition to those mentioned, however, we have found other and not unexpected sources of interest and helpfulness arising through the clinic. Diagnoses made in individual cases or advice given to a patient have often been transmitted to an employer, with the result that he has thereby first recognized the existence of a particular hazard in his plant or first seen how it may be controlled. Employers have frequently extended the advice to cover all men exposed to the hazard, or have investigated conditions not previously studied, or have sought further advice from us or from others. This has been especially true of the small employer who has but slight or no health service in his establishment, but it has repeatedly occurred with large plants as well.

Labor unions have also at times come to us for health advice because some of their members have been in the clinic. Fairly and tactfully carried out, the relations with labor unions may be made very useful in furthering industrial health, among other reasons because a clinic in a general hospital is obviously not subject to the suspicion that the unions unhappily often have toward the health service in their own industry.

The largest possibilities of useful development lie, however, in the research that can be carried out if the clinic acts as a center for co-ordinating the problems unearthed in it, with the health and technical departments of the industries on the one hand, and on the other, with the men and facilities found in medical schools and hospitals. There are, all told, among these two groups and their equipment the possibilities of attacking all sorts of problems and not infrequently of solving them. Research developments which will control or do away with hazards are, of course, in the long run far more important than the diagnosis and treatment of a group of cases, important as the latter is. In the past, problems in pure physiology, problems in metabolism or in biochemical matters, toxicological problems, problems of general hygiene and sanitation, and various other problems have appeared desirable as a consequence of observations in the hospital clinic. Some of these studies have been carried out with our colleagues in the medical school and hospital, in spite of the heavy pressure of war conditions. Studies have also been made in co-operation with physicians in charge of large plants and several corporations, some of them very large, have offered the co-operation of any portion of their research departments in working out the technical industrial end or the engineering aspect of some hazard, the existence of which was suggested by observations in the clinic.

In this way, as in most others, our clinic as well as our whole method of attack upon industrial medicine, from the hospital or from the academic standpoint, is really in its infancy, but progress thus far seems to open a vista of real public service if the varied departments of hospitals and medical schools can develop cordial co-operative relations with the health departments and technical departments of industries. Unlimited possibilities of good results with satisfaction and credit to both sides seem open, and the problems and the opportunities for interesting and serviceable work grow constantly as one studies the matter.

HEALTH EDUCATION IN INDUSTRY *

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IN the fight against premature death and disablement due to accident, injury, and illness, progress is being made in certain directions but not in others. The bacterial diseases with the exception of pneumonia, bronchitis, and influenza have been very greatly decreased. The death rate of infants and older children from all causes has been greatly decreased. These two decreases have been considered enough to lower greatly the death rate. Heart disease, Bright's disease, apoplexy, and diabetes have very materially increased.

We attempt to make a distinction between diseases due to habits and those due to customs. For instance, the bacterial diseases in the main are spread by community customs. The habits of the individual are of lesser importance than the mass habits called customs. On the other hand, in the case of diabetes the larger factor is the habit of the individual. While many flaws can be picked with this classification, in the main it serves to make a useful distinction with a reasonable degree of accuracy. Applying the rule, we find that in the main the diseases which are on the increase are those due to faulty habit. Another line of division would be on the basis of organized effort at prevention. Applying this rule broadly we find that the improvements have been in that group where preventive effort has been made and the lack of improvement has been in those where there has been neglect.

When we come to study accident rates we find that there has been a tendency upward for fifty years. The fatal death rates from all external causes by decades in Chicago since 1867 have been

1867–76	93.2
1877–86	90.6
1887–96	122.6
1897–06	106.3
1907–16	120.8

· The rates for 1917 and 1918 were 118.1 and 99.8 respectively.

* Read before the Health Section of the National Safety Council, Eighth Annual Safety Congress, Cleveland, October 3, 1919. Received for publication September 22, 1919.

Suggested Changes in Classification of Accidents

In an effort to analyze these figures I have come to this conclusion. In the rearrangement of the classification of the causes of death it would be wise to divide external causes into those where there is intent to injure and those without intent. The former are not related to carelessness. In this group there should go suicides, homicides, and legal executions — Numbers 155, 155a, 155b, 155c, 155d, 156, 157, 158, 159, 160, 161, 162, 163, 177, 182, 183, 184, 186a — eighteen causes in the Bertillon classification responsible for more than one-quarter of the deaths due to external causes.

I suggest that when the next revision of the Bertillon classification is being considered you be represented and that you endeavor to bring about such revisions in the nomenclature and classifications as will make it easier to marshal the facts relative to accidents. Also that you have proper governmental agencies collect and tabulate non-fatal accidents.

And now, returning after the digression, we find that the tendency of rates for deaths from all causes to rise is due to a rise in the rates for homicides, suicides, and what have been termed public accidents, and that this rise has been enough or more than enough to compensate for the decrease in industrial accidents. Between 1913 and 1917 the number of fatal accidents in industry fell from 25,000 to 22,000 — an improvement of 12 per cent., and the number of serious accidents from 700,000 to 500,000, and the number of accidents serious enough to keep a man from work six weeks or more from 300,000 to 26,000 — a fall of 26 per cent. This improvement was due to education of both employer and employee and the use of safer types of machinery.

During the last seven years the employer class has become greatly interested in accident prevention, the employee class moderately so, but the interest of the general public has lagged far behind. In 1917, of the 77,000 fatal accidents in the U. S. regis-

tration area, 55,000 were outside of industrial plants. Of the 510 fatal accidents in St. Louis in 1917, 400 were outside of industry. Of the total death rate from all causes in the registration area of about fourteen, a little more than one, or one-fourteenth of the whole, is due to violence. In 1901–1905 the violence rate was 101.7; in 1906–1910, it was 1.07. Since 1910 it has been: 1911, 1.04; 1912, 1.04; 1913, 1.08; 1914, 1.02; 1915, 0.99; 1916, 1.05; 1917, ?

As a sidelight showing the importance of fatal accidents in determining the total death rate, I call your attention to the attached table. This table shows the death rates per 1,000 from disease and from accidents among employees in the Canal Zone, between 1906 and 1907, and compares them with the fatal accident rate in the registration area in the United States. At one time the fatal accident rate in Panama was four and one-half times that in the United States. It is even yet one-third higher. The death rate from disease fell from a maximum of 40.5, thanks to intelligent, well-supported effort. The very high fatal accident rate fell only from 4.52 to 1.35 minimum. I hope when we come to build another canal we will have an accident prevention policy comparable to the disease prevention policy employed when the Panama Canal was being dug.

After showing the steady decline of accidents in industry between 1913 and 1919, Payne says, "There is another story for public accidents or accidents occurring in the home, on the street, and generally outside of industrial establishments. There has been a marked growth in the number of this type of accidents in the past few years. The reason for this rapid increase in the number of public accidents, while the industrial accidents have as rapidly declined, is that industrial managers are thoroughly aroused to the necessity of accident prevention in their plants but the public in general is still unconscious of the significance of safety."

To bring about the desired ends it is not enough to inform and instruct. That does not go far enough. The habits of the people must be changed. Each person must not only know what practices are safe and what are hazardous but he must apply such knowledge to himself. While his mind runs in its proper grooves and his muscles are doing their customary work, there must be a subconscious realization of hazards and an instantaneous response to stimuli of danger. It may be that a tendency to go about in an absentminded trance must be corrected or that a naturally poor inco-ordination and clumsiness must be overcome. This is the problem. How can it be solved? The solution when found is to be applied to the employer group including general managers, superintendents, and all bosses; the employee group includ-

Table Showing Number of Employees, Death Rates from all Causes, Death Rates from Disease and Death Rates from External Causes among the Employees of the Panama Canal Zone, 1906–1917 Inclusive

Year	No. employees	Death rate	Disease death rate	Death rate external causes
1906	26547	41.73	39.66	2.07
1907	39238	28.74	25.44	4.30
1908	43891	13.01	8.68	4.33
1909	47167	10.64	7.55	3.09
1910	50892	10.98	7.50	3.48
1911	48876	11.02	7.65	3.38
1912	51852	9.26	6.36	2.81
1913	56654	8.35	5.24	3.11
1914	44329	7.04	4.40	2.64
1915	34785	5.77	4.05	1.72
1916	33176	6.03	4.58	1.45
1917	32589	7.09	5.74	1.35

Note the following points:

1. The personnel referred to were almost all adult males.
2. Negroes predominated.
3. The work was done largely out of doors with heavy machinery. The climate was unhealthy but the efforts to control disease were exceptional. (In none of the reports is there any stress put on accident prevention.)
4. The fatal accident rates of 1908 (4.33) and 1907 (4.30) were higher than the disease death rate of 1915 (4.05), and only 1.44 per 1000 less than the death rate from all causes in 1916.
5. The death rate from disease after 1911 was exceedingly low.
6. The death rate from accidents was very high every year.
7. The improvement in the death rate from disease is far greater than the improvement in the fatal accident rate.
8. Dr. Gorgas explains that the very high death rate from disease in 1906 was due in greater part to an epidemic of pneumonia.
9. The rapid rise in the death rate due to external causes in 1907, he explains, is due to more blasting and railroad work.
10. In 1906, he says, there were 35 deaths among the white employees of which 19 were from disease and 16 from violence.

ing all who feel no responsibility for others; and the general public. The employer group are very well informed but many are indifferent for one reason or another. At least many do not act at all and others act somewhat thoughtlessly. The employee group are less well informed and less interested. The general public are most in need of information and of interest.

Recently a great professor in a great university wrote as follows of personal hygiene: "Personal hygiene is not a subject that can be advanced by public meetings. It has to be worked out by (or with) each person individually." A good answer to this opinion appeared in the headlines of a daily paper issued about the time this letter was received. It read: "Dress designers call for larger hips this season. Checks and stripes and lots of yellows appear to be favorites."

When fashion decrees that hips are to be larger, hips will be larger, or that checks, stripes, and lots of yellow are to be worn, you may be sure they will be worn. It will scarcely be denied that fashion determines wearing apparel, clothes, shoes, the shape of the feet, in great measure the food and the methods of its preparation, and in some measure hours of sleep. Now no one will contend that fashion is worked out by or with each person individually. An impulse, and not infrequently a convention of the interested, issues a decree and forthwith the civilized world obeys it. There is no other field where there is so little individuality, so little work by or with the individual.

All of the items specified in the above paragraph — clothes, shoes, food, sleeping hours — are matters of personal hygiene. Now personal hygiene is a matter of good habits on the one hand or bad ones on the other, and so is safety work when viewed from the standpoint of the general public. Personal hygiene and accident prevention are cut from the same cloth. What I have said about personal hygiene applies to accident prevention. If there is no field for any but individual effort in personal hygiene, the same holds true of accident prevention. On the other hand, if public work pronouncements, feats, discussions, newspaper articles, and publicity can effect changes in matters of personal hygiene, they can be effective in accident prevention.

I agree that the most effective method of education is by personal individual work. I am for it as strong as any one. But it has limitations which make it impossible as a solution of our difficulties. It is tedious, expensive, and requires too much machinery to be practicable as a means of meeting the whole situation. There are great possibilities for the group method even in educating adults. I propose to discuss some phases of some of the group methods.

Education of Adults

Moving Pictures. — This method of education is so well understood by you that I need not say much about it. Let me offer you this suggestion. Try one short run of lessons in a program of lighter stuff. When Health Commissioner of Chicago twelve years ago, I found that evenings devoted to health talks and health pictures lost their pulling power, whereupon I sent around to the moving-picture places single reel health films to be run unannounced between two numbers of the regular program, the audience being assembled with no thought of a health reel and in the main indifferent to such a subject.

Cards, Bulletins, and Booklets. — I recently read a criticism of the propaganda cards of the Chicago Health Department. For example, such a card as this — SWAT THE FLY, or this: DIRTY AIR MEANS DEATH. The particular card objected to was one saying that any sore throat was liable to be due to diphtheria bacilli and calling for a throat culture in every such case. The card was one displayed in street cars. The criticism was that the statements should have been qualified, that more information should have been conveyed, that brief, dogmatic, pragmatic statements were always inaccurate. Of course the criticism was justified. The Chicago Health Department recognizes this. They would not offer this card as a treatise on diphtheria. On the other hand a treatise on diphtheria has no place in the advertising space of a street car.

Once a pedagogue criticised a statement of mine to the effect that I was educating people, stating that I was instructing them. As I understand it, the word-sharks say that a man instructs when he imparts information but that he does not become an educator unless the instruction imparted "changes the ways of those who receive it." Now an essay on diphtheria is instructive but the chance that a street-car card will cause somebody to change his

ways is much greater if it uses a few words and perhaps a picture to put over a message. There is a place for the longer treatise, the essay. The whole question is one of salesmanship. Here are some men with information — the goods. Here are a lot of men in need of the goods but not especially anxious to buy. How can the goods be sold? That is the question. As I see it, the place of the complete treatise is for distribution among the leaders. The others will read it or understand it. The purpose is to instruct the leaders, with a view to having them translate the information, precept, point of view, into the psychology of the followers. The purpose of the short statement is to arrest the attention and secure the adoption of the man who is not greatly interested, who will not give attention for long, who will not make fine distinctions and who will not try to remember.

Slogans. — The men who advertise goods know the selling power of a slogan. Slogans to be effective must be short, catchy, and easily remembered. They must be positive. Negative slogans are not so effective. They must imply action. *Swat the Fly* fills all the indications well. *Do Not Spit* does not. In making cartoons, size of type, color schemes and pictures are matters to be carefully thought out. The use of slogans comes under a well-recognized principle of advertising. In the words of Lord Fisher, "Reiteration is the secret of conviction." It is well to change cards frequently as to location, type, color schemes. We become inattentive — blind to anything that is steadily before us. So much for the cards.

In between the cards and the booklets there comes a place for the leaflet. As to the leaflets I have certain suggestions to make. The fundamental suggestion is that you bear in mind the psychology of the men to be approached, giving it preference over the subject matter to be presented. The following suggestions are based upon this. Use should be made of the universal love of gossip. Wherever it is good judgment, bulletins should say something about individuals using names, addresses, and incidents, news of the plant. Incidents and occurrences should be made the basis of stories. Records of accidents should be published, making use of the spirit of competition. Advantage should be taken of symptoms, disorders, diseases, and accidents to distribute leaflets. There should be a series, with one for each group of subjects. I get between 50 and 100 letters a day. An analysis of these letters shows that for every one interested in prevention there are ten interested in the cure of a developed disorder — the actual figures being 66 and 660. This shows that the overwhelming interest is in developed conditions. "The devil was sick — the devil a monk would be." Although I write most about hay fever in the spring, nine-tenths of the people who write me about hay fever write well after the onset of the hay fever season.

Most diseases of the degenerative group are the result of bad habits. The most effective way to write about a given bad habit is to tie it up with some disease which grows out of it. Take one illustration. Tell the news about some person with diabetes, then touch on diabetes in general and finally expatiate on the habit of excessive sugar and bread eating; or give the news of some accident, tell of accidents of this type and then dilate upon carelessness. These make ideal presentations. In these longer presentations I can see no objection at all to exciting controversy.

Recently on successive nights I went to a forum where the room was crowded as it always is, and to a meeting of the board of directors of another forum called to discuss the advisability of discontinuing because of lack of interest and non-attendance. The reason for the success of the first was knowledge of salesmanship; of the failure of the latter, lack of such knowledge. I asked the platform manager as to the reason for his success. Among other things he told me was this: Always start a row. Always make somebody mad. Meetings thrive on controversy. Occasional bulletins containing controversial matter are in line with good salesmanship.

The approach to foreign language speaking people is at once easy and difficult. They do not read English and most of them read very little in any language. But this very fact means that their minds are not dulled by a multitude of impressions. Anything that you can get across goes big. Slogans are usually slangy. Slang does not translate well. Prizes for slogans in tongues other than English will bring forth some that are catchy for foreigners.

I suggest that concerns employing foreign-speaking people use the newspapers of those people for accident-prevention education. They read their newspapers through even to the advertisements. I sug-

gest that in matter written for these newspapers there be some stories written with the thought of harmfulness, of carelessness, and the benefit of caution inferred constituting the accepted key thought, yet nowhere stated. I suggest that in these articles suggestions of control and compulsion be minimized.

Speakers. — Since so many foreign-speaking people do not read, it might be well to employ some pensioners and disabled men as conversers, talkers — a functionary corresponding somewhat to the Jewish *schnorrer*. Go among the men and subtly talk the harmfulness of accidents. But the larger field for personal and oral presentation will be lectures and demonstrations. Many of you have made very efficient use of lectures, illustrated and non-illustrated. Let me suggest that you vary your method occasionally by introducing a brief lecture unexpectedly into a program arranged on a basis of entertainment solely. Thus you will secure a little of the time and thought of the indifferent. Such a lecturer, remembering the lack of interest of most of his audience, will do well to speak briefly, epigrammatically, making use of catchy, easily-remembered phrases.

Still-Life Pictures. — On the market there are now several automatic projection machines. These can be used to advantage if their pictures and texts are frequently freshened and if the location of the machines is changed occasionally.

Talking Machines. — Occasionally advantageous use can be made of talking machines. For instance, short talks by Judge Gary, Mr. Rockefeller, Lloyd George, President Wilson and the presidents of great corporations would prove effective.

Expositions, Museums, and Kindred Methods. — Of service in educating employers are museums of safety and other permanent exhibits, such as the display in the rooms of the Illinois Labor Bureau. Hazardous machines with dangerous parts may be advantageously set in rest rooms.

So much for the education of adults — always a difficult thing to accomplish, expensive and wasteful.

Education of Children

The education of children is a far more satisfactory field. I have read with interest *Education in Accident Prevention*, prepared by Dr. E. G. Payne upon request of the National Safety Council. It is a guide-book for teachers. In other words, it may be considered an excellent work for the education of teachers in the teaching of accident prevention. The U. S. Public Health Service and various state boards of health have prepared text-books on health subjects to take the place of ordinary readers. As I understand it, none of these have ever come into very wide use. Teachers have explained to me that they must use the adopted text-books and no book agents ever attend the meeting of the adoption boards to secure the adoption of these free health readers. If you go into the text-book field there is but one way to do and that is to play the game as it is played. It might be advisable for you to consider co-operation with the health people in the production of readers, spellers, and other texts making use of such stories as you could furnish as material for the books.

There is a general agreement among teachers that teaching should deal more with the experiences of the day. Even first and second readers would be more interesting if they carried some experiences from the workshop and the home rather than many of the stilted, far-away stories now carried. But when you get into this field, if you do, play the game as it is played.

Payne says while industrial accidents are limited very largely to adults, the same is not true of public accidents. In 1916, 10,534 children under 10 years of age in the registration area were killed by accidents, with perhaps 250,000 others severely injured.

Discipline. — This is a good place to say that discipline is a most potent factor in the prevention of accidents. Childhood is the time to teach discipline.

Workmen's Compensation. — Far and away the most potent educational influence in accident prevention was the passage of the workmen's compensation laws. The placing of accidents on an economic basis was directly responsible for much of the result. A great part of its effect came through creating a background for the National Safety Council and its superb educational work. Thus indirectly and directly workmen's compensation was responsible for the Safety First movement. Personally, I would like to see the application of the same principle to prevention of accidents in fields other than in industry and to the general prevention of disease.

THE CO-ORDINATION OF INDUSTRIAL AND COMMUNITY HEALTH ACTIVITIES*

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IN the early history of medical service in industry the employment of a physician in a plant was considered an evidence of a benevolent attitude on the part of the employer. The protection secured against excessive costs resulting from accident and injury, the shortening of the period of disability, the relation of the doctor to relief agencies and the doctor's value as an intermediary in industrial relations established more or less the value of the plant physician as a member of the operating staff; and as a result of really meritorious work on the part of a few pioneers in the field, it became evident that pre-employment examinations, as well as periodic re-examinations, prolonged the usefulness of the employed both to the industry and to the individual, to his family and therefore to society.

Probably the greatest opportunity for the promotion of the public health has arisen through the rapid development in industry of medical departments — manned as these departments should be by medical men giving their full time and thought to the conservation of human lives. In the discussion of our subject, a review of the relationship of the public health department, of the medical profession and of the public would seem, perhaps, profitable.

Public health is a field which embraces sociology, engineering, chemistry and bacteriology, as well as medicine, and the man with administrative gifts may have qualified for his post through any one of these allied sciences. The fact of a man's being a competent physician does not make him a qualified health officer. Public health is a science and art in itself and peculiar to itself, the essential being that the official should have studied and practised this science and art. If he be a medical man, his position, with the present professional viewpoint, is strengthened with his profession and with the public.

As Drake has well stated, a health department, in performing the functions imposed upon it by law, must reach, more or less directly, every person within its jurisdiction. The past generation has witnessed radical changes in the theory of preventative medicine. Officials are no longer permitted merely to meet emergencies as they arise. Health promotion has become more important than disease prevention, and disease prevention has come to be more regarded than disease suppression. The archaic policy of acting only in the development of emergency, of merely being ready to make the best of a bad situation in repairing damage after it has occurred, has been relegated to a less enlightened day. In carrying out its work of prevention, a health department must endeavor to arouse the interest and attention of individuals rather than of the masses or classes. It has become axiomatic that the government relation can only be as strong as the individuals who constitute it; but it must be borne in mind that public health is a matter for state and the nation — not merely individual towns or cities, and the war experiences demonstrated that disability, preventable in character, is far more prevalent than we have been conscious of or willing to admit.

An aggressive health department employs every possible means of publicity — the public press, as well as the other agencies of which I shall speak later — in an effort to maintain a personal contact. Unfortunately public health publicity costs money and, to be obtained, must be paid for. The controllers of the public purse strings have not yet arisen to the importance of this function, and, excepting in the few instances in which private funds are available for the promotion and support of publicity, the endeavor has failed. The success or failure of any endeavor for the betterment of public health depends, to a great extent, upon the attitude of the medical profession. In the main, that attitude is sympathetic and encouraging. However, there have been measures of very decided public value involving principles of social and economic worth that have been so strongly opposed that their value has been

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lost to the community. The canons of the medical profession provide that the first duty of the physician is to the individual, whereas in preventable diseases, the first duty is to the public.

Throughout a relatively brief but active relation with the medical profession it has been observed that the individual doctor has been so occupied with the specific case that he has all too frequently permitted others to direct the social, economic, and professional adjustments that modern progress has made necessary — this, notwithstanding that the professional interests and those of the public are identical and should be solved and applied only by a socially-minded medical leadership. The present day is intolerant of isolation from affairs. With others, the doctor must become active and not only support and direct actively but create those remedies for the ills of society with which he is or should be familiar. Unless medicine does this and makes apparent its group strength before the people, the people will all too frequently be victimized by the various cults and pseudo-medical interests that quickly grasp the importance of public control and especially with legislative and governmental interests.

Science has developed facts that have afforded remarkable opportunity to progress, but, in so doing, serious obligations have been imposed upon the doctor. Changes in health administration have, at times, been radical, perhaps revolutionary, but no more radical and no more revolutionary than the changes that have come to our scientific thought. The modern health administration, in asking much, is likewise giving much to the physician. The individualization of health work, instead of threatening the material interest of the doctor, actually benefits him in many ways. The more intimately the individual doctor becomes acquainted with the aims and purposes and underlying motives of the modern health department, the more valuable his influence becomes to the people of his community and the more useful the department becomes to him in the pursuit of his practice.

Health officials are now urging periodical physical examinations for all persons as the means of detecting insidious organic diseases in their incipient and easily curable stages, and while the medical profession may be called upon at certain times to render service gratuitous, or with small direct return, in such examinations for the purpose of education and demonstration, it is true that the establishment of this excellent custom is not only likely to save or prolong the lives of thousands, but in the ultimate brings largely increased returns to the physician. The more people think health and talk health, the more generally they seek medical counsel and guidance, consequently the more generally the physician is employed. It is invariably true, whenever there are established anti-tuberculosis leagues, with their dispensaries, medical nursing service, together with the educational and publicity campaigns essential to their success, those medical men specializing in tuberculosis, as well as the general practitioner, have an increased clientele among those actually suffering from tuberculosis and seeking treatment for it, as well as those who come to think seriously of their own physical condition on account of the agitation of the subject. This is similarly true in communities in which campaigns against venereal diseases have been undertaken. In such communities the venereal specialists and general practitioners report an increased demand for this service and, of course, this means that the uninformed have not sought the advice of the advertising or itinerant quack. This well illustrates the fact that that which is best for the people of the community and that which may be over-insistently urged upon them, redound to the material advancement of the reputable physician.

The physical examination of school-children with the discovery of the enormous number of defects of the upper air passages of the ears and mouth, heretofore regarded as relatively harmless, has conferred enormous physical benefit to the community as well as to the financial state of the medical man. This same helpful attitude is maintained by the diagnostic laboratory in its relation with the medical profession. While such laboratories are maintained for the benefit of the people as a whole, the service of the laboratory is rendered almost wholly through physicians. Occasional specimens are received from laymen but the name of the attending physician always accompanies the specimen, and a report sent to the physician, and in practically every instance it is found that such specimens are sent with

the advice of the doctor. In the case of Wassermann tests, it is doubtful if the laboratory ever received a specimen, except from a physician. This is similarly true of specimens from patients suspected to be suffering from diphtheria, typhoid and the other communicable diseases. In actual practice the laboratory is maintained wholly for the convenience of the medical man, saving the individual hours of labor and no inconsiderable outlay of money and if one may judge by the increasing demand for laboratory service, this convenience is becoming generally appreciated. On the other hand, the more generally the members of the medical profession engage in modern health activities in their own community, the more quickly they utilize the service of the staff of the several divisions of the department, the more constantly they employ the services of the laboratory for the exact diagnoses, the greater assistance they are rendering the government in meeting its obligations to the people.

The closest possible relation should exist between the private or industrial physician and the public health official. Public health departments heretofore have been limited in their relations with individuals for the purpose of teaching personal hygiene. The industrial health department can be made the new and strong arm of the public health department in bringing about precaution in matters of health. Morbidity statistics not now available may be secured, as well as organized assistance in times of epidemic.

The demand for this sort of service by the far-seeing executive, unappreciative of the necessary qualifications of a medical director capable of undertaking the responsibility, has led many medical men, the recent graduate, the unsuccessful or moderately so, into the field of industrial medicine; but until qualified men are created by university training or long and varied experience, the cause of industrial medicine, and in turn of industry itself, will not obtain the largest measure of benefit. It no longer suffices for an industrial organization of any size to employ a part-time physician who utilizes his job to pay office rent or automobile upkeep. The physician who considers accident work or casually surgery as a mere "pot boiler" or "stop gap" for a period of financial stress will hardly prove ornamental to his profession.

To meet the present-day requirement of a medical director it seems that the following qualifications, in addition to a medical degree, are essential:

At least five years of general practice — in that a knowledge of man and his foibles may be acquired. During this period it is necessary that the future industrial physician should maintain a connection with the public health agencies, such as the city health department with its various dispensaries, the general dispensary, and other public medical service, in order to develop the social viewpoint as well as to broaden professional skill.

The industrial physician should have a knowledge of practice, not necessarily profound, of the fundamentals of industrial relations and these include applied preventative medicine, medical and psychopathic medical investigation, recreation, accident prevention and the methods leading thereto.

He should have knowledge of the special problems relating to the employment of women and children; some knowledge of pensions and insurance, including liability, group and social; some knowledge of plant organization, which is likely to prove effective in dealing with the problems of labor.

He should have knowledge of employment methods; some notion of job analysis, physical and mental tests, to determine the fitness of applicants; knowledge of race problems, knowledge of industrial training, apprenticeship, continuation schools for training in particular jobs; and at least some knowledge in relation to the cost of living according to local standards.

He should have knowledge of the hours of work in relation to fatigue and output; knowledge of shift systems, rest periods, regularity, absenteeism, etc.

He should have at least a superficial knowledge of the security and continuity of employment in slack seasons, while convalescing from accident or disease, in case of labor-saving improvements, as well as with the advent of old age.

He should have a general knowledge of physical working conditions, safeguards, disagreeable gases and dusts; heating, lighting, ventilation, locker rooms, wash rooms, rest rooms, restaurants, hospitals, laundries, toilets, showers, plant beautification, drinking water. Of course he should be responsible for the physical examination of applicants and the periodic re-examination of employees, as well as the medical attention to families of employees when such is supplied.

He should have very definite knowledge of housing, transportation, recreational and educational facilities; the transfer and replacement of misfits, or as has been said "fitting the square peg to the round hole."

He should be familiar with the follow-up work, especially among new employees and with the injured; the replacement of injured and crippled employees.

He should have at least some knowledge of the athletic and social activities, company stores, com-

missaries, the type of house suitable for economic administration and housing problems generally.

He should be familiar with labor turnover and its cost; designs and data for the construction and operation of hospitals, lunch rooms, neighborhood and community houses; general education and Americanization, together with a knowledge of broad methods of raising the standard of employees' living conditions and ideals.

In the foregoing I have perhaps wandered far afield with the object, however, of indicating that the medical man with a broad view and such knowledge, however general, will be of such great value to the organization and every person in it as to command the highest respect, wield a constant influence, find his post seeking him, and incidentally name his own salary.

With the broadening of concept, a few plant service departments have extended this field by supplementing a series of lectures, or by other means, bringing attention to the various phases of preventive medicine, emphasizing their social and economic value.

That which has made America great in industry is her faculty of bringing together energies hitherto rambling and misdirected into a rounded concrete whole with largely amplified production. The mainspring of production or success is individual action and not state action. Success is nothing more nor less than opportunity for the individual. The enlightened business man of today sees clearly that the measure of his success is almost directly in proportion to the degree of opportunity his operation creates for others. But of what value is opportunity, lacking its essential adjuvant — the individual in good health?

In the United States there are 1,500,000 people constantly sick with preventable diseases, and 8,000,000 men between the ages of 18 and 45 are physically or mentally subnormal. While most of us are born with good health, we have but a brief existence before we carry within us, or are exposed without to the agency of our destruction. From a recent report by Irving Fisher of Yale we are informed that there are approximately 3,000,000 persons in the United States suffering from some form of sickness, of whom 1,100,000 are in the working or productive period of life, three-fourths being actual workers who must lose at least \$700 per year, which aggregates \$550,000,000. The expense of medicine, medical attention, hospitals, extra food, etc., at least equals this amount. Thus we have a total cost of illness amounting to \$1,100,000,000 at least one-half of which is preventable.

The sick man is a burden to the community, while the well man is an asset. Out of every hundred who are 25 years old today, thirty-six will be dead at 65, fifty-three dependent upon relatives and charity, six self-supporting and only five well off. It has been shown that of families dependent upon charity 77 per cent. of the members were physically unfit.

A most effective method of reaching the employee and his family is through the house organ, which, if well edited, is a welcome visitor to the domestic circle of each employee. It is well, of course, that the printed column should be supplemented by presentations by the medical staff of the organization, who should reach groups of employees orally or directly, as opportunity may offer, by means of the stereopticon or the motion picture. It has been my practice in lecturing to groups of employees and their families to discuss industrial medicine in accordance with the following scheme, closing the course by discussing problems and hazards peculiar to our own industry.

Physical examinations — their immediate and remote value — are considered by likening the human body to some well-known machine or device in the plant and demonstrating the analogy between the wornout and exhausted parts and the organs of the human body, emphasizing the vital importance of maintenance and repair. This method can be readily applied to such organs as the kidneys, lungs, liver, circulatory apparatus, etc. The acute and chronic infections, whether of industrial or general origin, and their importance are pointed out.

The subject of *personal hygiene* is simply presented, utilizing the diseases or defects that have come to recent attention in the plant as a basis for illustration.

The subject of *sanitation* is presented systematically by following the plan of organization of modern health departments and their various divisions; for instance, the department of sanitation. The discussion includes the nuisances: sewerage and sewage disposal; garbage, its collection and disposal; domestic animals, flies, mosquitoes, etc., together with the importance of good housing and the effects of bad housing and lodging houses. The spot

maps made by health departments indicating the highest tubercular rate, the highest communicable disease rates (excepting perhaps typhoid fever), the greatest juvenile delinquency, crime, drunkenness, and so on through the entire category of social ills, match exactly the spot maps indicating the greatest housing congestion.

Some years ago the Department of Health of Cleveland, through Miss Cadsey, made a study of two districts, one being in the old crowded section of the city and the other in an outlying section, Newburgh way, which is composed largely of employees of the steel mills. Rents were practically the same. In the first district in 1907 to 1914, there were 980 cases of tuberculosis recorded, 52 per 1,000 of population. In the second there were 450 cases, or 28 per 1,000 of population. In the first district in 1912 there were 665 of communicable diseases, or 3 per 1,000. In the second, 286 cases, or 1.29 per 1,000 of population. From the foregoing, little computation is required to fix definitely in dollars and cents the higher value of life in the uncongested section.

It must be borne in mind that a house is not a mere place for shelter. It must provide that which will promote efficiency in labor and strength of character and citizenship. The house connotes the family; the family and not the individual is the unit of our civic structure. It is now well recognized that in the modern factory, at least, the employee is in a better environment than in his own home. It seems the height of folly for industry to expend many times the per capita cost of health administration on the maintenance of healthful surroundings in the factory and permit the ostensible beneficiary to return to a home environment carrying the elements potent with destruction to the individual worker, his children and posterity.

Under the head of *communicable diseases*, prevention, treatment and a simple discussion of antitoxins, vaccines, their manufacture and use, the length and importance of quarantine, etc., are considered. *Venereal infections* and their effects, heretofore shrouded in mystery and crime and not discussed with candor and intelligence, are discussed freely, as they have now come to be recognized as the most important of communicable diseases. This subject almost always enlists and holds the attention of an audience. It is amazing that the average individual knows so little or nothing of the remote effects of venereal infection.

Tuberculosis presents a wide and interesting field. Its relation to housing, overcrowding, food, hours of labor, fatigue, rest, sleep, etc., are pointed out.

In connection with *child hygiene*, in addition to the child itself, pre-natal care, reference to obstetrics, obstetrical procedure and infant feeding are discussed. The value of the medical examination of children is emphasized. *Industrial hygiene* is intimately related to child hygiene, yet when children leave school and enter active life the health authorities lose sight of them. Industrial hygiene is an important feature in public health work and it is plainly the duty of some authority to supervise these young men and women during the early period of their industrial activity.

Under the heading of *food and dairy inspection*, the production, cooling, handling, shipping, storage and delivery of milk, together with the food value, the importance of bovine tuberculosis, the dangers of the unsanitary market, and the handling of food in the home, are referred to.

In connection with *vital statistics*, birth registration and its importance invariably attract attention.

The *laboratory* affords opportunity for a simple discussion of culture taking and examination of diphtheria, typhoid, gonorrhea, syphilis, etc. These subjects always enlist the closest attention of an audience. A description of the examination of water and its importance is also interesting.

These and other health department activities, presented even with haste, hold the attention of an audience for half to three-quarters of an hour and bring forth questions indicating not a little grasp of the subjects discussed.

Supplementing the lectures, it is advisable to offer a motion picture show. Stereopticon and motion pictures appeal to shop employees and their families and large and appreciative audiences are readily obtained either in the shop or at meetings under the management of employees associations which now exist among larger industries. Films are available from many sources. Our government, in co-operation with other governments, together with educational and industrial institutions, maintains at Washington a Bureau of Commercial Economics, which has a large series of films on most of the subjects of personal

and public welfare. The various state and municipal health departments and practically all of the state and national organizations for promoting health have series of pictures presenting strongly dramatic appeals on the subjects having their attention. The American Child Hygiene Association, the Social Hygiene Association, the National Tuberculosis Association, the American Medical Association, the National Housing Association, and others supply for a very modest cost sufficient material for a season of bi-weekly or monthly lectures.

A satisfactory series of lectures by the works' physician is difficult for the reason that most of our present-day industrial surgeons in small plants are part-time employees having neither the disposition, qualifications nor time to discuss community problems. Unfortunately again the physician is trained to individualism, seeing only the case and not viewing disease in its community aspect. His services are usually limited to advice to individual patients, and, if interested and conscientious, this service is of course valuable and to him is due the highest credit for the discharge of this responsibility. That there is an opportunity for the industrial physician to make a great contribution to the advancement of public health cannot be gainsaid. The work is clearly desirable; but at what cost and how shall it be brought about?

In 1916, the National Industrial Conference Board surveyed ninety-nine leading industries in an endeavor to ascertain the cost of health supervision in industry. It was disclosed that the cost incident to the care of 495,544 employees was $1,238,485, or $2.50 per capita. The budget of the New York Health Department is $3,957,-202.15, or in round figures, $4,000,000. The population according to the Bureau of Census, July 1, 1918, is 5,872,143, or roundly, 6,000,000. Hence it is that the per capita expenditure is about 67 cents. The population of Cleveland in the same year was 810,306 and its Health Department expenditure slightly less than $250,-000, or somewhat over 30 cents per capita. This lack of expenditure does not include, however, the maintenance of hospitals. If industry sees its way clear to make an outlay of $2.50 per employee, surely it is possible for the community to make a somewhat larger output and obtain returns wholly out of proportion to the sum expended by industry and that from the public funds.

It is clear, therefore, that there is an overlapping of effort with no inconsiderable waste of money. Experience has shown that there are three stages to the development of social movements: a period of agitation, a period of organization and a period of final incorporation of the desired order of things. It is obviously the time for beginning an agitation having for its object the centralization of public health education and control in some centralized governmental authority. This organization might well stand sponsor for such a movement. It is unfortunate that the present scope of function of the United States Public Health Service could not include the administration of compensation funds and other forms of social insurance likely to eventuate, which, in accord with the claims of their advocates, will react to the prevention of disease.

It is perhaps more courageous than discreet to suggest that business in its present attitude toward government control, complete or partial, of social or economic function, pool its interest in a small group of the community with that of the community as a whole. Nevertheless, with the advantage demonstrated, executives are quick to respond to the demands of the period. It would seem entirely feasible to consolidate the function of compensation commissions with that of national, state or municipal departments of health, or, if the principle of states' rights interferes, it would be workable to bring about co-operation between the agencies, with the point of contact resting upon the state department, to the end that their respective functions be applied to a single or at least to correlated effort which would make its impress on the whole community in the better understanding of the purpose and value of preventive medicine.

MALINGERING — INVOLVING THE PROBLEM OF GETTING THE SICK OR INJURED EMPLOYEE BACK TO WORK*

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MALINGERING may be defined as the conscious and deliberate feigning of illness or injury, or as the intentional exaggeration of symptoms. Some comparative zoölogists, after studying the animal kingdom, say that malingering is a form of self-preservation — an offshoot of fear. In the animals it is called instinct. If one stops to analyze the cases of malingering in respect to nationality, physiognomy, and mentality, there are evidences that this "instinct," as it were, is a real thing, and a trait which supports Darwin's theory of evolution. History and literature have recognized malingerers since the beginning of the world. The earliest instance known is recorded in Genesis, Chapter 31, Verse 35, where Rachel, in 1056 B.C. malingered in order to secrete the stolen idols of Laban. What boy in our day hasn't malingered in order to attend the ball game, carry water for the elephants, go fishing, or escape an unprepared lesson? While the problem is old, yet in these fast-moving days of industrial activity there are new aspects which must be considered. The various methods of malingering, the tests for its detection, and the training of the doctors for this special branch are food for later papers.

That admirable legislation known as the Workmen's Compensation Act, now operating in the majority of the states, has given us an opportunity to study closely the injured employee, and, where occupational diseases are included, has stimulated interest in the sick employee.

In justice to the workmen in general, I believe malingerers to be in the minority. The ideas brought out in this paper are for the purpose of detecting and curing an ulcer which causes the innocent to suffer, and by its cure will cause the honestly-disabled employee to receive all the honor, sympathy, and consideration due him.

The malingering employees may be roughly classed as:

A. Dishonest employees who say little.

B. Exaggerating employees who are less experienced and therefore voluble to make the most of their injuries.

"Fakirs"

The dishonest employees or "fakirs" are those who have a slight or no accident or illness. They report an injury and become immediately disabled. The doctor finds little or nothing upon physical examination, but, willing to be always fair, gives the employee the benefit of the doubt and sends him home. His disability becomes total, and on account of "pain" he says he cannot work. If he has a slight cold he reports sick and says the pain in his chest keeps him from work. A physical examination shows no evidence of illness.

Where settlements are permitted, as among longshoremen under the Admiralty Law, foreign labor is urged and often assisted to malinger by the "runners" or "shysters." Within the last three months I have seen the following malingering cases of this class:

1. B. C., aged 38, Italian, married, was lightly hit by a draft of boxes and was supposed to have injured his left shoulder. He went to a doctor, who treated him every day. Physical examination three weeks from the date of the accident for the purpose of determining the extent of disability, showed inability to raise the left arm and, upon palpation, a very tender shoulder joint. After various tests, no signs of fracture or changes in or about the joints were discovered. There was a mottled blue area of skin about 4 inches in circumference over the shoulder. The "bruises" were superficial and not deep. Investigation confirmed the suspicion that these "bruises" were caused by someone sucking the skin of the shoulder, and making what the boys call "fox bite." Had the man had a real injury the settlement would have been in proportion and the "runner" would have had a larger fee. In this case the employee was dishonest and the "runner" tried to assist him to be more dishonest with the hope for greater benefits.

2. P. Q., aged 16, Hebrew, married, claimed to be walking along a warehouse when he slipped on a banana peel. In trying to catch himself he bent backward and hit his head and the middle of his back upon some crates standing near. No one saw

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the accident, but a doctor strapped his back. When examined there was a blistered area of skin across the small of the back, which proved to have been made by a hot poker in order to fool the examining doctor. While his back was being examined, his clothes were dropped down about his ankles, and his hat placed upon the floor. During the examination he claimed inability to bend forward. Upon being left alone he was seen, through a peek slit from another room, to bend over, pull up his clothes and pick up his hat.

Flagrant malingering where the claimant is dishonest, unassisted, is seen as in the following cases:

1. M. N., German-born, aged 22, draughtsman, was injured in Niagara Falls. He claimed that while lifting one end of a drawing board he felt pain in both groins. Physical examination showed a large indirect inguinal hernia on both sides. He claimed never to have had a lump on either side before. He insisted upon operation by his New York family doctor and not the insurance company's doctor. His doctor used carbolic acid in mistake for novocaine, burned the skin from the boy's navel to his knees and he became sterile by the contraction of the scar tissue over the cords. Investigation showed that the drawing board weighed 12 pounds and his end, therefore, weighed 6 pounds. His could not have been a traumatic hernia. This malingering caused loss of services and money to the employer and much suffering with permanent disability for the malingerer.

2. M. M. was led in by a young girl. He stated he was 51, married, with his family in Italy, and had been burned in both eyes by live steam. He claimed to be able to distinguish light and dark only. External physical examination seemed to bear this out, except for the fact that his eyes quickly followed the dropping of a ring to where it rolled. While he was faced toward the window his coat was put on another chair, his hat hung in a darkened corner of the room, and his glasses changed to another position on the desk and partially hid by a paper. His ability and agility in finding them while talking about compensation led to his claim being rejected.

3. A young man, formerly an acrobat, aged 28, married, sprained his ankles while carrying a heavy chain. He returned to work in three weeks, compensation was paid and the case evidently closed. He apparently did the same and heavier work for nine months. Then he laid off and asked for a rehearing. Physical examination was negative. X-ray was negative, yet he held his feet almost rigid. Several doctors, including the chief surgeon of an accident board, could find no cause for his complaint that " the pain in his ankles was so bad he couldn't work." I could not elicit the usual evidences of pain, and finally had him kneel in a chair facing the back. His feet hung rigidly. Tapping the achilles tendons caused an unexpected free extension of the feet. This movement was not painful. This was one of the very few cases where I felt justified in testifying " this man has no pain." Despite the negative evidence, the board awarded compensation. Leaving the building, the employee said to me " I guess I didn't talk up to them enough. S. told me that he talked up and was given $3000 and I got less than $1000." After the settlement he had no further need for his cane.

Exaggeration of Symptoms

The second class is composed of employees who have been ill or injured so that the evidences are present upon physical examination, and yet who claim to be unable to return to work. In these cases the physical examination shows exaggeration of symptoms. The men decide not to return to work until they are as " fit as the day they quit." This class may be divided into (1) those who are in the age-group, 25 to 40, and (2) those who are in the age-group, 55 to 75.

The age-group from 25 to 40 contains many malingerers who desire time off because when idle they make more money, as for example, in the following case: J. C. belongs to several lodges or mutual benefit societies, whereby the total weekly benefits, including compensation, exceed his average weekly wage. His wife may also be working and adding her mite. In these days of high wages and comparatively low compensation benefits this class has fallen off in numbers, but in ordinary times these employees we always have with us. The men find it much easier to have free medical attention, to have high weekly benefits, and to be able to sit around and talk or read, than to have to work in order to earn the amount sufficient for their needs. This is especially so when the earning power is less productive than the benefits.

The age-group from 55 to 75 years — the winter season of life — usually contains men who own a little property purchased with their savings, and have rent practically free. They have children who are married, and any at home usually contribute, so that the income from compensation boards, lodges, and members of the family, with an occasional gratuity from the employer, is more than sufficient to feed and clothe the family. These men are satisfied to sit around and talk and do the chores, but when it comes to work they claim inability of all sorts. A good example of this class resides in the city of Buffalo. His history is as follows:

K. K., aged 62, married, with no children, while working for his brother as a carpenter, fell a distance of 10 feet and landed on both heels. He fractured

both heel bones. The injuries were promptly and properly treated. The slight swelling of the legs, common to inactive men of his age, appeared occasionally, and there was a slight deformity due to callous formation in the left heel. He was fitted with proper arch supports and shoes, baked and massaged, and after a period of total disability for fifty-two weeks, was told to return to work. The brother-employer was approached concerning re-employment of K. K. He said he thought K. K. should rest, and thereby prolonged the disability, because K. K. would "work for nobody but his brother." K. K. claimed pain in the muscles of his leg after standing awhile, and pain in the bones of his feet at night. He refused to try to do anything. Five years after the accident the examination revealed nothing more than the usual results of this type of fracture. Investigation proved that he owned his home, did the chores, cut the grass, cared for his garden, hoed the potatoes, and yet exaggerated his symptoms, so that the insurance carrier has paid him $15 per week for five years, with the prospect of paying him as long as he lives, and the chance of supporting his widow afterwards.

Statistics show that more employees malinger who are injured than those who are ill. This is probably due to the legal liability feature. If compulsory health insurance becomes a law, the American people will be astonished at the days lost through sickness in comparison with the days lost now. The curve will increase each year as it did with workmen's compensation. Malingering is harder to detect in illness claims. We will deal with our problem of returning the employee to work, with a tendency toward the accident feature. Necessarily this will involve problems of workingmen's compensation administration.

Problem of Returning a Malingerer to Work

The problem of returning the injured or sick malingerer should be attacked as the medical profession attacks diseases. The premise is that the disease is present. To treat it properly there must be a knowledge of the causes, the symptoms and signs of the illness itself, and the cure by (1) preventative measures, so that others will not be afflicted, and (2) the treatment of the diseased one by eradication of the symptoms.

A. As to the Premise there is no argument. No sane person doubts its existence.

B. The Causes of Malingering:

These are many, and because of their importance in treatment they should be mentioned in order.

1. *The Employee.* Starting with the malingerer himself we must consider him as to his age, sex, education, and mentality.

Among foreign elements all ages tend to exaggerate and malinger, especially the Latin races. The American youth, except in rare instances, wants to be back at work as soon as possible. His future is before him. At about 50 years of age, a man begins to consider work as a means of existence and takes pride in his past achievements. He begins to feel that society owes him a rest and a pension, and exaggerates accordingly. Some older men, with the pride of years of service behind them, will drag themselves to work if possible that their record may not be broken. Men with such spirit are the real heroes of labor. Unfortunately human nature seeks rest as the sun of life sinks.

The influx of women workers during the world war has been too recent for reliable statistics. It would seem, however, that their ambition and ability to endure would result in far less malingering in proportion than among the male sex.

The less educated, the more lazy a man is. Conversely, as the mind improves its status so does the malingering become lessened. There seems to arise an ambition which refuses to be downed by ill luck. Therefore, lack of education is recognized as a cause of malingering.

The mental attitude of the employee is interesting on account of the motives discovered. (*a*) The employee may be revengeful and feel that his employer owes him more than the law provides, or that the prolongation of disability will tend to get even with the employer for some real or fancied wrongs. (*b*) He may be ambitious for attention, sympathy, and alms. All clinics have those who make regular rounds year after year. The hospitals, charity organization societies, churches, lodges, and various benevolent societies know this type well. (*c*) He may be defective mentally, and this type includes the fanatics, the convulsionists, the hystericals, imitators, and manic-depressive cases.

2. *The Employer.* Employers may be divided into two classes for our purpose. (*a*) One class is composed of those who are too generous. They pay full wages for time lost, irrespective of compensation laws. In some few cases this would be extremely gracious and well deserved, but the temptation of nature to prolong disability is too strong in the vast majority of cases. (*b*)

The other class is just as close and indifferent as possible. While I was trying to induce a president of a large concern to introduce a sanitary lunch room, hospital, and first-aid organization, he said: "Why should I try to make it pleasant and safe for those fellows aside from my question of rate? The whole 5000 would walk out tomorrow and not think about me if an agitator trumped up some fancied wrong." Had he paid more attention to the men's comforts, organized safety-first units, learned a few men's names, dropped a smile or word of commendation here and there, or built up a brotherhood among the employees, there would be little economic loss through malingering. Personal interest properly exercised breeds loyalty among employees that even instinct cannot abuse very much. Keeping the employees informed as to statistics of work in past years for comparison, and accident frequency with loss in terms of sick or injured days, will go far to arouse an unbeatable pride in the workmen's hearts. A lack of interest on the part of the employer means a lack of proper follow-up methods and does much to favor malingering.

3. *The Industrial Accident Boards.*—These foster malingering by: (*a*) having no facilities for quick hearings in malingering cases as soon as they are detected. In some states it takes from two to six weeks to have a case appear on the calendar after application for hearing has been made. If detected, the malingerer knows he will be given consideration at least to the date of the hearings, which gives him added weeks of benefits, which he otherwise would not receive. Industrial accident boards foster malingering further by (*b*) urging legislation raising the amount of compensation indiscriminately. The man with a sore finger can do work of some kind where the man with a broken leg could not get out to look for it. The helplessness of the latter requires greater expenditures and should have a higher rate. In other words, a scale depending upon the degree of disability should be chosen. The simpler the injury, or the more undue the prolongation of an accident, in like proportion the smaller the benefits called for. The most worthy should be entitled to the maximum benefits. Malingering is fostered by high benefits. Accident boards foster malingering by (*c*) mixing politics and sentiment with business. Very few appearing before various state boards have not seen an elaborate staging of a case with relatives for supporting parts, in order to sway the board, and the subsequent sympathy cause a ruling not upheld by the higher courts. Many have seen union cards and political affiliations worked to the limit, because the law says that the board shall be the sole judge of fact. With proper "introductions" the malingerer is confident that the board may be generous. Again, boards foster malingering by (*d*) failure to prosecute perjurers or malingerers when so proven. This freedom from prosecution is a source of comfort to the malingerer. What has he to lose? Lastly, accident boards foster malingering by (*e*) failure to have a competent medical member of the commission, whose duty would be to arbitrate all medical cases. He would weigh the opinion of the chief medical examiner against the testimony of the insurance company's doctor, or the claimant's doctor. Malingerers could not then trust to the ignorance of a lay mind concerning the importance of the medical problems involved, or the symptoms presented.

4. *The Medical Profession*, sad to relate, contributes much toward malingering.

(*a*) Family doctors depend upon the families and their friends for their practice. They feel they cannot afford to get on the wrong side of any fence, consequently the malingerer preys on them for certificates of extended disability which the doctor can later usually back up with some kind of opinion. (*b*) Lodge and society doctors are in the same class and their reappointment the following year depends on the vote of the lodge. These doctors rarely perjure themselves for a few dollars, but they will stretch the truth. Malingerers get certificates comparatively easy from such men. (*c*) The shyster doctor, as well as lawyer, we have with us. To such, the truth means nothing and they trust to their personality to convince lay board members of a fearful and wonderful condition in the claimant. This type of doctor has his "price." (*d*) Incompetent doctors treating all manner of cases prolong and sometimes provoke disability unduly, and discourage the injured or sick. Thus they encourage malingering.

5. *The "Third Party."*—The so-called friendly enemy or runner who learns a few symptoms of disability and how to produce them artificially in some cases. This person, plus a natural malingerer, makes a hard

combination to beat. The runner is after his percentage and the higher the cost to the employer, the greater his profits.

C. The detection and methods of detection of the signs and symptoms of malingering will be left to the industrial surgeon or specialist in malingering. Suffice to say that the diseases having been proved present, we next consider the treatment.

D. Treatment.

1. *Prevention or Prophylaxis.* — This consists chiefly in correcting or removing the causes.

As for the employee; pension the faithful employees before they are added to the industrial scrap heap, stimulate pride in men to outdo the women in stick-to-it-iveness. Educate them at least to an awakening interest; determine the mental attitude by physical and social examination before employment and eliminate the mentally unfit. The moral and physical hazard of those employees in daily contact would be greatly increased if no defectives were allowed on duty.

The employer should be kind, gentle, courteous, and jolly, but firm and not unwisely generous. He should make the employees feel it is their business also, and each man is a spoke in the wheel which will not run smoothly if a spoke is missing. He should advocate employees' clubs, comforts, and organizations, and encourage them with his occasional personal supervision.

The industrial accident boards should have one-day emergency calendars presided over by a commissioner who is a competent surgeon and specialist in malingering; a fair scale of benefits so that the worthy receive their due; a high sense of honor as custodians of hundreds of thousands of dollars of employers' moneys; an understanding that politics and sentiment must be minimized in relation to business and the law, and the prosecution or assisting the district attorney to prosecute all malingerers and perjurers so proven.

The medical profession will from now on contain trained industrial surgeons. Progressive colleges are beginning the courses. These should supplant the family, lodge, society, shyster or incompetent doctor. These surgeons should be supported by industry, but not subservient to it.

The boards and employers should refuse to discuss a case wherein there was a runner or shyster lawyer. These vultures prey upon the laborer's ignorance of his rights under the law and demand a percentage of that to which the law says the laborer is entitled. There is no need for the runner and he should be eliminated.

2. *The Active Treatment of Malingering.* — The problem resolves itself into the fact that these employees are lingering and loitering on the threshold of industry. How best to encourage their voluntary return?

(*a*) Starting at the beginning of employment the application blank should have these questions on it:

1. Have you had any previous accidents? Explain.
2. Have you had any previous illnesses? Explain.
3. Are you now in good health?

A malingerer is not necessarily a *good* liar, for a good liar remembers his previous story.

(*b*) There should be a careful physical examination before employment. Defects can be noted so that minor injuries cannot be amplified.

(*c*) Accidents or illnesses must be reported by someone within twelve to twenty-four hours after occurrence or they cannot be considered. Employers should be protected by the law in this. A physician makes an immediate examination and controls the case, then a smashed finger at home cannot be charged to industry; a gonorrheal joint cannot be referred to a strain two week previous; lumbago cannot be called sprain at work. Of course where eye particles give trouble next day, or infection sets in three days after a scratch, there are definite signs of presumptive injury while at work.

(*d*) Proper organization.

1. Chief surgeon. A trained industrial surgeon who has specialized in malingering. He should have a pleasant and forceful manner, be a business man and well read. He must have a convincing manner on the stand and have tact.
2. Assistants, as many as necessary, to treat all injured men immediately upon report of accident or illness, and to make thorough examinations before employment and at any time where necessary.
3. Nurses who can pleasantly jolly a malingerer, and if possible shame him into going back to work.

4. One or more social service nurses, male or female, to check up and investigate any suspicious action or questionable testimony. These nurses should have a claim training so that they know a few details which they could attend to when necessary.

(*e*) Proper system.

A system to lessen malingering could be used as follows: —

As soon as an employee reports ill or injured he has prompt attention by a doctor. The doctor's report, estimate of disability and history of the case seen the previous day, is filed every morning. The employment card is attached to his history and physical examination card and becomes part of it. These cards or files go to a doctor for comparison. If the case looks legitimate, the treatment continues until disability from that illness or injury ceases. The file then is placed back in the filing system and the case closed. If the case looks questionable, the facts are investigated by the social service department and action taken accordingly.

If the claimant later tries to reopen his case claiming all sorts of symptoms, he can be confronted with his previous well-kept record.

If disability lasts over four weeks the case automatically goes out of the assistant's hands until the chief surgeon shall have made an examination and report. The chief's word is final; the man goes to work or receives further treatment — general, operative, or reconstructive. This gives also the advantage of the chief surgeon's being able to watch the work of his assistants. At any time an employee is thought to be malingering, the report should be made confidentially to the chief surgeon.

The scheme may be expanded into the realms of state medicine. It may also grow into a clearing house for information concerning dishonest employees, such as the life and accident and health companies support. When an employee is dishonest to the point of malingering he should be known, that the honest employees be not made to suffer by his actions. This would reduce the number of so-called " traumatic hernias " alone, so that the saving in this one type would pay for the bureau.

This scheme is also applicable to any group of employers or insurance carriers in any one city where the individual system might be too expensive for any one employer.

(*f*) Proper punishment.

A firm hand by the industrial boards in dealing with malingerers is essential. It matters not whether benefits are cut off on the date the employee should have shown his good will and attempted to resume some work upon the physician's advice, or on the knowledge that detection of malingering will certainly be punished by the boards or courts — the employee who is faking will fear the consequences. Fear goes a great way to keep people straight who otherwise might be intentional malingerers. This fraud is the meanest of all and should be severely dealt with.

(*g*) Expert diagnosticians.

This group would include a well-paid medical commissioner, skilled in industrial medicine and surgery and in the detection of malingering, and well-paid chief medical examiners.

Employees may have their own opinions, but they cannot seem to learn that working, after certain disabilities, will do more for them than medicines or treatment in hastening a cure. The difference between the patient's visiting his own doctor and being examined by the commission's expert is that in the former case the patient seeks advice, while in the latter case the patient squeezes symptoms to fit the condition. The former doctor is perhaps biased. The expert is unbiased, and while giving the employee the benefit of the doubt, he is an administrator of justice to all, especially to that great class of honest employees who say: "I don't want anything for myself. I want a good body and to get back on the job."

The expert should be acquainted with industrial conditions so that his judgment as to a finger injury would be fair to a tailor, or watchmaker, while the same injury would be less disabling to a foreman or driver, and the return to work order should accordingly be influenced.

The expert should study the individual and know character. He should know when to agree with dishonest complaints and when not to agree.

He should have a fair knowledge of decisions of state boards and courts in various types of cases, as his questions and the answers thereto may prove of great value to the commission in legally interpreting a malingerer's statement.

Finally, he should have a thorough knowledge of pathology. This is essential

to account for many of the symptoms alleged by a malingerer. It is of untold value in the hundreds of tests to check malingerers. That is something of which the malingerer knows nothing. This will stop the testimony of unscrupulous doctors concerning a wonderful pathological condition, purely invented in the hope that the lay members of the board will give the patient the benefits.

Conclusions

In attempting to recognize the disease, investigate the causes, and treat the condition, there has been one point in view — that of returning the sick or injured employees, who tend to malinger, to work in the shortest time consistent with good recovery. This saves an economic loss to the employer and protects the honestly-disabled employee, who by reason of his honesty should profit in proportion as the malingerer should suffer. The American spirit is justice for all. Stress has been laid on well-trained industrial surgeons. This is because, in my opinion, few mistakes could be more serious or do more real harm than to stigmatize an honest man a malingerer. It is possible by proper methods to prove malingering. At the point of doubt the medical commissioner is essential and his opinion should prevail on all medical questions. A number of malingerers get surprisingly well before they will be examined by the chief surgeon or medical commissioner.

The malingerers cause the medical profession making impartial examinations to view any case with suspicion until proven innocent. If we can minimize the number of malingerers we shall have done much for the honest sufferer. We shall also save the toiler from moral degradation which follows misspent time and unearned income. The detection of malingering is a highly specialized branch of medicine, for by it society pays its just debts, fraudulent claims against innocent parties are prevented, and industry receives back the men as useful members instead of their being leeches on society.

BOOK REVIEWS

Commercial Tests and How to Use Them. By Sherwin Cody. Paper, pp. 238. Yonkers-on-Hudson, N. Y.: World Book Co., 1919.

This is a manual of the standardized tests of the Business Standards Association (formerly the National Associated Schools of Scientific Business), and it is an outgrowth of the work of a joint committee of the Chicago Association of Commerce and the Board of Education, first reported in 1913, and since extended by national organization. A brief account of the organization and of its preliminary bulletins and series of tests is given. The book contains introductory chapters on tests as a scientific basis for school marks, for estimating progress, and for measuring practical ability, but the greater part of the space is given to a full description of the tests. No statistical data are presented, and the mathematical treatment of the tests is confined to some practical directions for recording and scoring the results.

The tests are eleven in number, with two series given for each test. They include: (1) a test on tabulation, in which items specified by three factors are selected from a mixed series (chosen with some reference to its value as a test of mental alertness); (2) reproducing instructions, the subject being required to comprehend and reproduce the details of a complex order; (3) test on invoicing, which comprises entering of a business transaction in proper form; (4) fundamental arithmetical operations, tested for speed and accuracy; (5) tests in business arithmetic; (6) tests in English, including spelling and grammar; (7) elementary test in letter writing; (8) test on answering letters; (9) stenographic test; (10) test on copying for the mimeograph; (11) test on addressing envelopes with a pen, and on filing. Each test has been definitely standardized, and full materials and directions are given for every step in the process of testing and grading.

The usefulness of such standardized examinations for business ability cannot be questioned, and the methods explained in the book are obviously far superior to the ordinary methods of grading in schools, but the question will be likely to be raised by some psychologists whether tests could not be devised which, by following less closely the routine processes of the school and the technical work of the office, would be to a greater extent tests of ability as contrasted with the special erudition of business. This problem is not entirely overlooked by the author, since some directions are given for estimating general ability from the results of the tests, but this might well have been extended and brought into closer relations with the standard methods in use for testing general ability. At least one must recommend to the amateur business psychologist that, in using such a manual as this, he familiarize himself with the current methods of measuring intelligence.

In the actual employment of commercial tests, a system must of course be arranged and applied in such a way that the effects of intensive work for a short period will not offset or hide general disqualification, and also that defects in incidental teaching will not conceal potentiality and capacity for progress. If actual present knowledge and control of the specific processes employed in business are what the business man desires most to measure, standardization of tests in direct relation to these processes, such as this manual carries out, is highly practical and effective and, at least for rough estimates of the lower grades of business ability, sufficient criteria (the amount and character of training being known) may perhaps be obtained from commercial tests of this type.

This book ought to be found in the library of every employment department and to be thoroughly understood by all teachers of commercial subjects.

G. E. Partridge.

The Creative Impulse in Industry. A Proposition for Educators. By Helen Marot. Cloth. Pp. 146. New York: E. P. Dutton & Company, 1918.

The vocational and industrial school movement is too circumscribed by industrial thought; educators oppose the control of such schools by industrial enterprise, fearing that the students will be exploited by business interests; on the other hand, education must be vocational in order to keep in touch with real life problems. Germany has developed a great system of industrial education. Before the war many were in favor of its most efficient methods, not seeing that its paternalism was the token of an enslaved people, not seeing that children were being sacrificed to an industrial institution for an imperial purpose. But now our eyes are opened and we must see that the efficiency we strive for is not to make an empire, not to pay immediate dividends, but to develop man's desire to do creative work. The creative process is the educative process.

Modern business enterprise and machine technology have extinguished the joy of the creative experience; craftsmanship is a thing of the past; an article owes its existence to an infinite number of persons, and a worker's claim to the product of his labor is merged in an infinity of claims which totally impersonalizes industry. The worker has become a mere factory attachment and surrenders himself to the rhythm of the machine. Thus creative desire has been lost and the only reason left for laboring is the predatory desire to possess wealth — to "get paid off" and do as little work as possible for as large a reward as possible. Division of labor is not as bad as it seems, however, for it offers the workers the possibility of extensive social intercourse and the opportunity to work out a co-ordinated industrial life.

The American way of adapting labor to industry has been the assumption of detailed control by the management, leaving to the worker only a set of instructions which he is to follow blindly. To compensate for robbing the worker of initiative and con-

tentment in his work the management introduces "welfare work"; but even this humanitarian "slop-over" of the scientific manager does not keep the man from slacking, being perverse, or throwing over his job. At least scientific management is honest and the worker is under no delusion that he is working on his own initiative. The stupidity of the situation lies in the belief by the managers that the workers lack initiative and that the pay envelope satisfies all their desires. The development in this direction is the recent desire of labor to assume responsibility for administration whether industry is publicly or privately owned.

The German way of adapting labor to industry has been to educate the children, sort them out at the age of ten, and at that time practically determine their future social and economic status, this to be followed up by several years of special training, giving no opportunity for any element of waywardness or free choice. They are taught to accept methods and not to doubt authority. The necessity for Prussian imperial position inspired the surrender of German schools to the needs of the German manufacturer. The school children were exploited for the needs of the state; they were given the ideal of service to the state as the great incentive, and because machine industry was imposed ready-made on a people whose psychology was feudal, the method was remarkably efficient.

The last chapter in the books is constructive and outlines a plan for industrial education as opposed to industrial training, the prime object being to keep the creative instinct alive. The school is to be an experiment to determine whether through education the creative experience may be enjoyed in association with other workers in spite of the division of labor. To accomplish this the worker must be given a true participation in productive enterprise and must be shown that "there are adventurous possibilities in industry outside the meagre offerings of the pay envelope. Without question, it is the business of educators to determine whether such features of industry as machinery and the division of labor are fundamentally opposed to growth or whether they are opposed only in the way in which they have been put to use and directed." — *Stanley Cobb.*

Recreation for Teachers: or the Teacher's Leisure Time. By Henry S Curtis. Pp. 288, with illustrations. New York: The Macmillan Company, 1918.

Dr. Curtis has presented his subject in an unusual and original way, and his book invites comment from several points of view. It is, first, a sufficiently systematic study of the requirements as regards recreation — or, more broadly, life outside the routine of work — of an exceptional profession of which about half the members, according to certain statistical studies, suffer from some form of "nervous trouble." The excessive wear and strain of the work of teaching and the long periods of freedom from work common among teachers, make the hygienic problems of this profession peculiar. At the same time, Dr. Curtis insists, the general plan of life outlined for teachers is suitable in essentials for all professional workers. In this plan, recreation takes rather a larger place than we are accustomed to give to it, but the author has, in his own mind, so interwoven the idea of play with that of work that he has avoided the extreme of pleading for too much play for play's sake, and also the other extreme of trying to justify the inroads of play by always making it practical. Practicality is sought in the total result, while the play instinct is satisfied by the spontaneity of life that the author is plainly trying to show the teacher how to acquire, both in work and in play.

If in presenting the problem of hygiene in this unconventional way the writer sometimes descends to the commonplace, he does succeed in suggesting, out of an abundance of experience, what he is trying to convey — an ideal of a larger life for the teacher which is full of the spirit of nature and in which hygiene as such falls into the background or becomes a part of natural living. The book seems to be wholly free from the hobbyism that we often find in books on health that depart from the beaten path. One could wish heartily that every profession and occupational group could be submitted to a similar examination by investigators having as wide a knowledge of the conditions and requirements as has been brought to bear upon this study.

The book contains some new data: statistical summaries in regard to the prevalence of diseases among teachers as compared with other groups; and a variety of special investigations, largely by questionnaire, of the activities of teachers, which show, on the whole, narrowness of life and lack of ability to make the best use of opportunities or to react from the peculiar effects of the fatigue and routine of the work of teaching. A wide range of topics is covered. After some general considerations of play and of teaching and of the special needs of teachers, the recreational resources of teachers are discussed under such captions as After School, Saturday, Sunday, Week-Ends, The Teacher's Institute, The Summer at Home, Summer Work, Summer Teaching, Summer Play, Recreation at Summer Schools.

Life out-of-doors and a higher living through the senses as contrasted with mere activity are the writer's persistent themes. The book has an Emersonian touch, and there is an occasional bit of philosophizing worth remembering, such as that "friendships do not grow largely out of work but out of play," leading one to consider what else can be introduced into the occupational life only through the medium of play. — *G. E. Partridge.*

British Labor and the War: Reconstructors for a New World. By Paul V Kellogg and Arthur Gleason. Pp. 496, including 153 pages of appendix. New York: Boni and Liveright, 1919

This book should be of particular interest to those who are following the present trend in the labor movement in England. Its aim is to show how a new constructive labor policy grew up during the war to supersede the old established trade union idea. The authors are Americans and present their material from the standpoint of the outsider, though always from the standpoint of the outsider who is sympa-

thetic with labor. Those in this country who have felt that recent tendencies among British labor give signs of social and political disintegration, will obtain a new view of the possible currents of thought and motive underlying the changes which are in process. The book does not at any point consider the possibility that the fundamental trend of thought among British workers can lead to anything but a new era of industrial and political democracy. This new democracy will be evolved, rather than set up, by such a change as has come in Russia. A great deal of reliance is placed upon the good sense of the Britisher who has in the past successfully carried on bloodless revolutions of various types.

Up to the fall of 1917, British labor had developed no unit front on policies of war and later reconstruction. With the statement of war aims adopted at the joint conference of the Trades Union Congress and the Labor party in December, 1917, however, a definite policy was established to which labor could look for such a termination of the war as would protect it in all countries from a recurrence of a similar catastrophe. This Statement of War Aims offered a common ground upon which all labor could be drawn together in England. With the growth of unity on the larger issues of the war in England, labor's next step was to establish a similar understanding of war aims among the workers of the Allies. The Inter-Allied Labor and Socialist Conference of February, 1918, was, as its chairman stated, "the first occasion on which the workers had unitedly evinced a determination to take a dominating part in the issues of war and peace." Growing out of the deliberations of this conference was the Memorandum on War Aims which, based upon the Statement of War Aims of the conference of December, 1917, emphasized the fundamental need for insuring the safety of democracy throughout the world, and went into some detail on the question of the settlement of territorial disputes arising out of the war.

The third phase of labor's offensive in the war was "to get their conception of an unimperialistic settlement before the workers of the Central Empires." In accomplishing this latter purpose, labor found a great ally in President Wilson toward the close of the war, when he appealed directly to the people of the Central Empires.

Along with the development of a war policy, British labor was laying the foundation for marked changes in its relation to industry and to the government. The new industrial movement "claims that the producer must control production." The new political movement "deals primarily with man, the consumer, rather than with man, the producer." The one deals with management of production, the other with the nationalization of the means of production. Out of these new trends have grown the shop committee movement and the growing demand for nationalization of such resources as mines.

With the entrance of the United States into the war, British and American labor interests became more closely connected. On most points of war policy Mr. Gompers, on his visit to England in September, 1918, could agree with British labor. The American Federation of Labor, however, would not "meet the representatives of enemy countries until the war had been won." The majority of British labor distinguished sharply between the autocracy and the workers of the Central Powers, and under certain conditions was willing to confer with representatives of the latter, even while the war was in progress.

While the authors of this book are most interested in happenings, the closing chapters look toward the future as it promises a new democracy for workers. One of the most valuable parts of the book is the appendices which present a series of memorable documents which have grown out of the new attitude of labor toward itself and its environment.

Much of the subject matter of the book is composed of quotations from speeches and writings, so that the discussion deals extensively with original sources. While this gives much weight to certain chapters, it tends to make the book somewhat lengthy and, at times, slightly confusing to the casual reader. Although the avowed purpose is to present labor's story, one wishes that its activities had not been so completely segregated from those of other forces which also played their part in winning the war. The book, however, is well worth reading and presents a great amount of information which impresses the reader with the feeling that out of the apparent confusion of immediate reconstruction will come a new and altogether more satisfactory order of things. — *Charles H. Paull.*

Health Education in Rural Schools. By J. Mace Andress, Head of the Department of Psychology and Hygiene, Boston Normal School. Pp. 321. Boston: Houghton Mifflin Company, 1919.

Dr. Andress has produced a very useful book. It claims little or no originality as regards new research, but as a text-book in the field of popular hygiene it is excellent. Although it is especially adapted to the work of the teacher in a rural community and treats specifically some of the problems of the country, in all essentials the study is general and both in text and references is suitable for the use of all who are interested, in a practical way, in the health of children.

The question of the comparison of the health and sanitariness of conditions in country and city Dr. Andress treats by accumulating the available data. The old view that the people of the country are healthier than those of the city and that conditions are necessarily better in the country is now discredited, or at least the relations have become changed. Health surveys within a few years have shown not only that there is even a greater amount of physical defect in the country, but that housing conditions are bad, and even overcrowding is prevalent. The results of the draft have confirmed these conclusions to the extent of showing that men from the country are as likely to be physically defective to a degree sufficient to exclude them from military service as men from the city. The fact that a great proportion of the defects found might have been prevented by ordinary hygienic conditions and such

care as can now readily be provided in a routine way through the schools, encourages us to redouble our efforts and to extend vigorously our preventive resources to include the schoolchildren of the rural communities, who now constitute three-fifths of the school population of the country. At the present time there is but little teaching of hygiene in the country schools, and, in fact, the health of the children outside the cities is to a dangerous degree neglected. Draining away of the more vigorous stock of the country into the industrial life of the city is also having the effect of causing deterioration in country life and depletion of its vitality. — *G. E. Partridge.*

Education in Accident Prevention. By E. George Payne, Ph.D., President of the Harris Teachers College, St. Louis, Missouri. Cloth Pp. 149 and index, with illustrations. Chicago: Lyons & Carnahan. 1919.

This small but very important book is designed to show " how accident prevention may be made a part of regular school instruction without the addition of another subject to the curriculum." Too much credit cannot be given to the National Safety Council for their enterprise in providing for such a publication and to Dr. Payne for the able manner in which he has constructed the book.

The first chapter, *The Economics of Accident Prevention*, is of value to all interested in industrial hygiene. It gives most cogent reasons for the entire safety movement. Following this are general chapters upon the scope of the work and the importance of inculcating careful habits as regards safety. The need of making such habits a social duty is emphasized. How important such teaching may be, comes home to all of us when we consider the delight in taking risks which possesses most children. To place such tendencies in a class with lying and thieving is an important duty for modern society.

Following this general outline of the subject are suggestive chapters on *Teaching Accident Prevention through Language Instruction*, *Accident Prevention through Drawing*, *Accident Prevention in Arithmetic Instruction*, and *Accident Prevention in Other Subjects*. It is, of course, clear that any campaign against accidents which is to be successful with children must treat of fields that they can appreciate. But it must be of certain benefit to industry if eventually it receives workmen who have started to be careful in the days of their earliest impressions. Such individuals will not need to be taught industrial accident prevention. They will enforce it and will cause the safety movement to spread from within. — *C. K. Drinker.*

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SYPHILIS IN RAILROAD EMPLOYEES *

(A CLINICAL STUDY OF AN OCCUPATIONAL GROUP)

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THE writers have been for some time under the impression that syphilis is an exceptionally common disease among railroad employees and that it constitutes a grave and unrecognized menace to their personal welfare and industrial efficiency, and to the safety of the travelling public. In order to ascertain the statistical basis for this impression a review of 3000 unselected histories of Mayo Clinic patients was made with a view to comparing the amount of syphilitic infection in railroad men with that of certain other occupational types. Of these histories 1657 were grouped under occupational heads fairly representative of the average American citizen. The 1657 cases included men and their wives, 1143 of the former and 514 of the latter. The presence of syphilis was demonstrated in these cases by a searching examination in the Section on Dermatology and Syphilology following their routine general examination. In connection with the general study a special study was made, based on the records of fifty syphilitic railroad employees, taken at random from the files of the Section, with a view to determining if possible the types of late complications most prevalent among them and the methods best suited to the detection of the disease in their examination.

Table 1 presents the relative portions of syphilitic infection in the general occupational types considered.

It would be inaccurate to conclude that because a given percentage of the sick have syphilis, the same percentage would hold in a through and through survey of sick and well. It seems probable, however, that the prevalence of a chronic and often latent infection such as syphilis can be more fairly estimated from a study of the sick than can that of an acute infection. The percentage of latent and concealed as well as active cases in industrial groups will perhaps bear a close relation to the share

TABLE 1

Occupational Types	Men Only		Husbands and Wives	
	Cases	Per Cent. Syphilis	Cases	Per Cent. Syphilis
Railroad employees	128	11.7	184	10.3
Laborers	243	6.1	297	6.9
Business men (tradesmen, merchants)	236	3.8	311	3.2
Farmers	536	1.5	865	1.4

of the disease in the production of their ill health. It would appear from this table that syphilis is approximately eight times as prevalent in railroad employees as in farmers, twice as prevalent as in common laborers, and three times as prevalent as in merchants and tradesmen. An interesting sidelight is thrown by these figures on the prevalence of syphilis in general as detectable by general medical examination. Currently accepted estimates based on the clinical judgment of syphilographers of large experience represent the disease to be present in from 10 to 15 per cent. of the adult population. In hospital patients,

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currently accepted surveys based on the Wassermann test average 19.2 per cent. (1, 4, 6). Our results showed that only 3.1 per cent. of syphilis was detected in our patients when subjected to general medical examination. Of 1143 men, 4.2 per cent. had syphilis; of the 514 women, 2.6 per cent. had syphilis.

It should be emphasized that the first step in the detection of syphilis in our cases was medical examination and not the routine Wassermann test. We feel that there is very little doubt that, had a routine instead of an optional test been employed, the percentage recognized would have been higher. At least part of the discrepancy between our figures and those quoted is, therefore, attributable to the weakness of unaided clinical judgment in the recognition of this disease. An uncertain portion of the discrepancy must, however, be attributed to the very large rural factor in the clientele of the clinic. There can be no doubt that the proportion of syphilis among our patients is reduced by the large proportion of farmers seen, among whom the disease is apparently relatively infrequent. The clientele of the Mayo Clinic is drawn, moreover, quite largely from those portions of the country in which the percentage of venereal infection is low, as indicated by the recently published geographical survey of the second million drafted men (5). The results of Wassermann surveys (on which high estimates are based) probably include an uncertain though small percentage of false positive results. Taking these various considerations into account, it seems to us not unreasonable to conclude that had we employed a routine Wassermann test on all patients our percentage of syphilis recognized would have been higher, although not so high as the estimates compiled from the clientele of city hospitals and dispensaries.

Attention has been called in the literature from time to time to the menace of syphilis of the central nervous system to the safety of the public, particularly when it takes the form of paresis and epileptiform seizures in men responsible for the operation of trains. Knapp discussed two cases of this type. Camp, before the Neurological Section of the American Medical Association, presented a study of epilepsy and paresis in railroad employees in which, after detailing five cases, he showed that of eighty-seven admissions to the state hospital at Kalamazoo, Michigan, within a given period, thirteen were of men employed in the operating department of railroads, five of whom were engineers.

The fifty railroad employees* whose cases were considered in our special survey included locomotive engineers, firemen, brakemen, switchmen, conductors (excluding dining car), section hands, yard foremen, inspectors, telegraph operators, signal maintainers, and station agents. Men of these types, aside from the responsibilities which devolve on them, form an especially interesting occupational group, medically speaking, because they have for years been ostensibly under medical surveillance, and their health record is, therefore, in a sense indicative of the efficiency of the industrial medical practice of the past. To find so high a percentage of the men infected with a grave disease, capable of seriously impairing their efficiency, and through that impairment, of bringing discredit on railroad administration and danger to the public, is a matter for concern. To find so much of the infection easily recognizable and yet apparently unrecognized, suggests the need for a modern revision of methods and conceptions in medical supervision.

Of the fifty men considered: One-third (36 per cent.) were on the engines. Three-fourths (76 per cent.) were engaged in the actual operation of trains (this includes engine crew). One-fourth were engaged in such occupations as yard foreman, section hand, telegrapher, etc.

The sexual habit of the men concerned may be inferred from the fact that of forty-two from whom data were obtained, 80 per cent. admitted at least one attack of gonorrhea.

The possible contributory effect of alcohol, both to infection and complications, is suggested by the fact that 61 per cent. were users, and 36 per cent. more than occasional drinkers.

The effect of syphilis and gonorrhea on the second generation in the group considered is suggested by the fact that of thirty-six marriages, 44 per cent. were either sterile (22 per cent.) or marred by miscarriages (22 per cent.).

The very limited value of a history of infection in detecting the presence of syphilis, on account of the tendency to masked

* See appendix to this article, in which the result of a duplicate survey is given, confirming the results in the first group.

onsets, is forcibly illustrated by the fact that 24 per cent. of the fifty syphilitics could give no history of infection other than gonorrhea. There were no recognizable secondary manifestations in 62.5 per cent. It should be accepted as axiomatic that the search for syphilis in a patient and in members of an industrial group must be *brought to the patient.* To wait for the individual to seek advice directly exposes him to the risk of late complications and to errors in diagnosis, all dependent on the unreliability of the subjective account where no symptoms may appear in the period intervening between infection and accident. Observations such as these serve to illustrate concretely the weak points of clinical examination when (as is too often the case in syphilis) the clinician relies on the history for his clue.

The age data on the cases furnished two interesting observations. One-fourth of the patients (26 per cent.) were infected between the seventeenth and twentieth years, one-third (32 per cent.) between the ages of 20 and 25. By their twenty-fifth year nearly 60 per cent. were infected; by their thirty-second year 91 per cent. were infected. It seems a practical suggestion, therefore, that since the efficiency of the Wassermann test is highest in the early years of the infection, the test could be applied to best advantage to the age-group, 17 to 25 (60 per cent. of infections), on entering railroad service, and repeated in the same group on reaching age 31 (91 per cent. of cases).

The age at which relief for late symptoms is sought suggests the age-group which, at the present time at least, should be subject to closest surveillance. Over one-third (34 per cent.) of the onsets of late complications were in the five-year period from the sixteenth to the twentieth year after infection, as against only 45 per cent. in a fifteen-year period among the remainder. Only 17 per cent. of late accidents developed after the twentieth year, and only 8.5 per cent. before the sixth year after infection.

If, therefore, 91 per cent. of infections occur between the ages of 17 and 31 and 71 per cent. of late accidents occur in a fourteen-year period between six and twenty years after infection, it would seem that oversight to prevent late accidents should not extend to the old men who are too often the recipients of special attention, but mainly to men over 23 and under 45. Nearly 70 per cent. of the men included in this series appeared for examination in the clinic before reaching the forty-fifth year, and one-third between the ages of 35 and 40. Yet two great railroad systems do not begin routine annual examinations until the employee reaches 50 years of age, and six out of eight content themselves with examination once in three years during the very period when syphilis in their personnel is most likely to endanger the lives of the public and of employees.

The seeming lack of connection between the presenting symptom and the actual disease process has always been a stumbling block to the recognition of syphilis by the general examiner. It was, in this series, responsible for many diagnostic errors. The dangers of the habit of grasping uncritically and unsuspectingly at the chief complaint instead of seeking the diagnostic sign are well illustrated by Table 2, representing the subjective or symptomatic side of an overwhelming preponderance of grave central nervous system and cardiovascular syphilis.

TABLE 2.—PRINCIPAL SYMPTOMS

		Per Cent.
1.	Gastric symptoms	28 (vomiting 10%)
2.	Complaints not suggesting syphilis, such as hernia, constipation, broken nose, etc.	18
3.	Headache and head pain ..	16
4.	Cardiac symptoms (pain, dyspnea, palpitation)	14
5.	Diplopia and poor vision ..	14
6.	Malaise, weakness	12
7.	Shooting pains	10
8.	Bladder symptoms	10
9.	Nervousness	8
10.	"Do I have syphilis?" ...	8
11.	Laryngeal symptoms	8 (4% supposed T.B.)
12.	"Rheumatism"	4
13.	Ataxia	4
14.	Girdle pains	4
15.	Dizziness	2

Nearly half (45 per cent.) of the cases in this series were not diagnosed or were misdiagnosed before the patients entered the clinic, and of these all but one were late cases. Of the 55 per cent. correctly diagnosed at some time as having syphilis, nearly half had been identified at a time when the diagnosis could scarcely have been escaped, that is, in the primary or secondary stage. It is difficult to avoid the belief that the lack of a history and the irrelevancy of some presenting symptom, on which the examiner is over-prone to

rely, materially contribute to the percentage of error.

The blood Wassermann reaction, the first great objective diagnostic earmark of syphilis in the general medical examination, was strongly positive in only 43 per cent. of our series. Four per cent. were weakly positive. Fifty-three per cent. of the cases were completely Wassermann-negative on the blood. There is nothing in this group to controvert the idea that Wassermanns taken on younger men (all but eight of our cases were more than 32) would yield a higher percentage of positive results if not obscured by treatment. There is much in these figures to discourage an uncritical reliance on the negative blood Wassermann as evidence of the absence of late syphilis.

The examination of the spinal fluid proved of more value than did that of the blood in the detection of syphilis in this group. Such an examination was made in only thirty-three of the fifty men, but should, we are now convinced, have been made in all of them. Nearly two-thirds (64 per cent.) had fluids positive on some one of the four points of the examination (increased globulin alone was not accepted as evidence), as contrasted with 47 per cent. positive on the blood. The cerebrospinal fluid findings did not parallel the symptomatology in degree, nor did the symptoms necessarily suggest involvement of the nervous system. Men were accordingly found to be actively at work on engines and in other responsible positions whose cell counts ranged as high as 139.

The purely laboratory procedures contributed 58.7 per cent. of the diagnoses. The remaining 41.3 per cent. were identified by the methods of routine physical examination. Among these, the recognition of pupillary abnormalities and fundus changes in the eye, the signs of cardiovascular involvement, and the neurologic changes stood out pre-eminent.

Of thirty-nine men, adequately examined from every standpoint that modern knowledge could suggest, 79.5 per cent. had syphilis of the nervous system; 18.7 per cent. had cardiovascular syphilis. The two co-existed in some cases. Some of the cardiovascular cases were not subjected to spinal puncture, although there is no doubt in our minds at the present time that puncture should have been done.

Cardiovascular abnormalities were recognizable as valvular lesions, aortitis, myocardial changes and their sequelae in 18.7 per cent.

Pupillary abnormalities, muscular paralyses and fundus changes proved to be among the most significant and valuable of signs, being present in 62.5 per cent. of the cases. The eye findings are classified in Table 3.

TABLE 3. — EYE FINDINGS

"Slow" reflexes	25 per cent. of 48 cases
Argyll Robertson pupils	37 per cent. of 48 cases
Unequal pupils	14.5 per cent. of 48 cases
Irregular pupils	14.5 per cent. of 48 cases
Muscular paralyses	12.5 per cent. of 48 cases
Fundus changes	26.5 per cent. of 34 cases

The presence of so high a percentage of abnormal eyes in a group of men whose eyes, of all the structures in their bodies, are ostensibly subject to the keenest scrutiny by railroad medical examiners, was a matter for astonishment. The inadequacies of the average railroad medical eye examination, which seems to be confined to vision and color sense and the remedial possibilities, suggest themselves at once. At least a clue to the presence of two-thirds of the syphilis we recognized in railroad men could have been had by so simple a procedure as the careful taking of pupillary reflexes.

Even an extremely simple neurologic examination, such as should properly be a part of any significant medical examination, revealed interesting facts. Omitting the details of the complete neurologic studies made on many of the cases by the Neurologic Department, the gross findings are summarized in Table 4.

TABLE 4. — GROSS NEUROLOGIC FINDINGS

Abnormal knee reflexes	65.1 per cent. of 43 cases
Abnormal Achilles reflexes	78.1 per cent. of 32 cases
Positive Romberg	38 per cent. of 39 cases
Speech defect	15.7 per cent. of 38 cases
Mental symptoms (diminished attention, irritability, amnesic attacks, etc.)	38.4 per cent. of 39 cases
Bladder involvement (cord, bladder, retention, incontinence, etc.)	47.5 per cent. of 40 cases
Ataxia	36.8 per cent. of 38 cases
Paresthesias	55.8 per cent. of 34 cases
Hemiplegia	7.1 per cent. of 42 cases
Loss of consciousness	7.1 per cent. of 42 cases

The high percentage of mental symptoms is especially interesting. Two patients had amnesic attacks, and it was apparently in one of these that one of the locomotive engineers in our series became

responsible for a breach of orders, running past a siding with a resulting collision of his freight with a passenger train. Many of the men were irritable, quarrelsome, inattentive or fuddled. One patient, a locomotive engineer in charge of a very large and powerful engine, subsequently described vividly his impulses to run engine, train and all through the terminal station building, and the subsidence of this dangerous irritability following the beginning of treatment. The records of these patients were taken before this study was contemplated and by another department, so that they are reasonably free from subjective interpretations.

In the effort to ascertain why so large a percentage of serious late syphilis escaped detection in railroad medical examinations, a questionnaire was sent to the medical departments of eight of the largest railroad systems in this country, explaining the purpose of the investigation and asking certain questions relating to their methods of examination. The very cordial cooperation of the heads of these departments, in replying in detail, developed the following facts: All of them require a general physical examination when employees of the types considered enter service. Six of the eight re-examine employees every third year thereafter, and in six the examination is for vision, color sense and hearing only. Four do Wassermann tests "on suspicion"; three do not do them; and only one road has a routine Wassermann test, and that on hospital patients only. Six of the eight make no special effort to recognize syphilis in their employees; two make a special effort, although in one, dining car conductors and waiters apparently receive more than their share of attention because of the directness of their contact with the public rather than because of their responsibility for the safety of trains. Three of the eight medical departments believe there is little syphilis among railroad men and that what little there is, is not responsible for accidents; three could make no estimate; and two believe the disease to be prevalent and an undetermined menace to public safety. Two roads make routine medical examinations of employees responsible for accidents, five make them on suspicion, and one does not. What should properly constitute suspicion was not defined. Four of the roads urge a more thorough examination for syphilis upon their medical staffs, two contend that there would be labor union objection, and one feels that only clinical detection of the disease without laboratory tests is practicable.

The situation with reference to syphilis in industrial medical inspection may be summarized in few words. The recognition of syphilis in the personnel of industrial units depends upon the adequate practice of modern clinical medicine. An examination such as the present railroad medical examination, which for any reason fails to detect gross evidence of syphilis in the objective examination of the eye, the heart, and the nervous system, cannot be construed as adequate. It is as much to the interest of the employee to have his syphilis detected before it disables him as it is to the interest of the road or the industry to do so before its exchequer, reputation and earning capacity are endangered by it. The technical demands of such examinations are not beyond the average competent examiner. It is doubly to the interest of the public that both parties to this situation should meet their obligations. The present railroad medical examination could, it seems to us, be improved as follows: first, by the performance of a careful routine Wassermann test on all employees between the ages of 17 and 25, either on entering service or as soon as possible thereafter. The growth of the free state Board of Health laboratory, and its increasing efficiency, might be considered as a means to this end. The Wassermann should be repeated on all men coming to the age of 32. Second, the present railroad medical examination could be improved by annual examination of men between 25 and 40 rather than of men more than 50, if a choice must be made. Such an examination should not be limited to vision, color sense and hearing, ignoring in its narrowness even the pupil of the eye, nor should it limit its consideration of the body to hernia and the results of injury. It should, moreover, invariably call for the fundamentals of a neurologic examination, if possible by a neurologist. The clues derived from it would point the way to special procedures. Third, propaganda for the education of both employees and medical staff to a better appreciation of the importance of syphilis in industrial efficiency and hygiene is in order. One of our brakemen of his own accord expressed the wish that his

road would send around a car equipped for educational purposes.

Some of the relations of syphilis in railroad employees to the problem of medical diagnosis, to public safety, and to industrial compensation are suggested in the following brief résumés of cases in this series.

Case 1 (255229). — An engineer in charge of a large superheater developed double vision. In spite of a definite history of infection, and probably because of a negative blood Wassermann, he was told by one physician that he had syphilis, and by another that he did not. He remained on duty until his own mental state alarmed him so much that he gave up his work and voluntarily submitted to a careful examination. He had the typical pupillary and reflex signs of a tabes dorsalis, a positive spinal fluid Wassermann test, globulin increased, 46 lymphocytes and a Lange in the indefinite zone. The decline in his irritability and the improvement in his mental state with treatment was striking. He remained at work throughout his treatment and now has a normal spinal fluid.

Case 2 (253897). — A locomotive engineer, aged 58, continued at work in a progressively bad condition for six months after the onset of definite symptoms. He finally quit voluntarily, and not at the instance of the road, on account of the severity of his dyspnea. On examination he was found to have advanced aortic endocarditis and aortitis, with a positive blood Wassermann test. He also had a duodenal ulcer. Under treatment for his syphilis he made a definite improvement.

Case 3 (245049). — A railroad brakeman, aged 42, in active service, complained of "rheumatic pains" when lifting, and a recent "strain" acquired while at work. He was on regular duty but of late had grown quarrelsome, was worrying a good deal, and expected to quit. He had been under treatment for syphilis without a complete diagnosis of his condition. On examination he was found to have the clinical, neurologic and serologic signs of a paresis. His mental condition was such that we advised his physician to make an effort to have him secure other than railroad employment.

Case 4 (253186). — A railroad brakeman, aged 33, on active duty, came to the clinic because of inguinal hernia. The accidental discovery of a positive Wassermann test on the blood led to a fuller investigation of his case. This disclosed Argyll Robertson pupils and the early reflex and sensory changes of a tabes dorsalis. The spinal fluid was negative.

Case 5 (264745). — A yardmaster whose last routine medical examination was in 1911, but who had been under the care of railroad physicians for fourteen months, came to the clinic for supposed laryngeal tuberculosis. He had never had a Wassermann test according to his statement. On the finding of a positive test he was placed on treatment and made a remarkably rapid and satisfactory recovery. His history showed that he had developed a mass on the shoulder, probably gummatous, following injury in line of duty, for which he was endeavoring to collect compensation from the road. He had at a previous time received compensation for complications following another injury which suggested the influence of syphilis as a cause of the complication. In addition to the foregoing he had been a continuous source of expense to the railroad for fourteen months during the treatment of a non-existent tuberculosis, only to have the real nature of the trouble identified by a Wassermann test.

Case 6 (240051). — A yardmaster, aged 47, came to the clinic with retention of urine. It developed that he had been catheterized daily for two weeks in a railroad hospital without a definite diagnosis, although a spinal puncture had been done. Three months before his appearance in the clinic he had been hit on the back by a brake club. No symptoms developed for five weeks, however. On careful inquiry it was found that he had had typical lightning pains and girdle sensations for three or four years, and considerable ataxia in the dark. A neurologic examination showed widely distributed sensory and reflex changes, not compatible with a traumatic lesion. The Wassermann test on the blood was negative repeatedly. The spinal fluid was Wassermann negative, Nonne was negative, but the cell count was 6; it later fell to 2 under treatment. At the end of the first course of treatment, retention still persisted but was less in degree. Three months later after treatment by inunctions, the retention had practically disappeared, the ataxia and lightning pains were gone and the patient had gained materially in weight.

In the presence of nearly negative serologic findings one hesitates to assign to syphilis the sole etiologic responsibility in this type of case. The neurologic examination, however, suggested the existence of an early cerebrospinal syphilis which probably served as the background of a process initiated or stimulated to activity by the blow on the back received in line of duty. Cases of this type illustrate how subtle may be the influence of obscure luetic infection on ailments and injuries for which workmen may seek compensation.

Case 7 (259845). — A railroad conductor on active duty, aged 37, came to the clinic complaining of constipation and a broken nose. The routine general examination at once disclosed the fact that he had unequal pupils, inactive to light. On being pressed for a history, he admitted a primary lesion in 1905 with some mouth medication and gave a history of shooting pains, attacks of dizziness and deafness in

the left ear. An examination of the spinal fluid showed a negative Wassermann test, a positive globulin test, a pleocytosis of 136 cells, and a gold sol test of 1112232100.

Case 8 (198014). — A locomotive engineer, aged 33, came to the clinic complaining of diarrhea. His trouble dated back eighteen months and was believed to have followed the eating of poisoned food at the end of a heavy run. It was not until sometime after the onset of diarrhea that his pre-existent cardiac symptoms came to the front. He died eight months after coming under observation of syphilitic aortitis and myocarditis and secondary damage to the liver and kidneys. He himself believed, and his family insisted, that his condition dated from an accident in line of duty at the time he was struck by the Johnson bar of his engine. An effort was made to secure a statement to this effect to serve as a basis for a compensation claim.

Case 9 (209706). — A railroad switchman, aged 31, had developed a squint two years before, for which he had sustained an operation. He had, however, been continued in railroad employ, without investigation of the cause of his squint. It was found that, although he came complaining of stomach trouble and rheumatism, he had a well-defined tabes dorsalis, although the Wassermann was negative on the blood and spinal fluid. His internal strabismus, probably an early sign of his condition, had apparently received no attention as a sign of syphilis from his physician.

Case 10 (163703). — A locomotive engineer, aged 36, at the time of his physical examination in the clinic, complained of difficulty in urination for which a physician had been treating him with sounds on the supposition that he had stricture. On examination he was found to have a positive Wassermann on the blood, and neurologic findings fairly distinctive of taboparesis. This patient was under observation and intensive treatment for a period of one and one-half years. He entered on a definite remission and during a period of about six months successfully carried his usual run. Suddenly, however, he returned to the clinic for observation and it developed that he had been " given ninety days " by his superintendent for his responsibility in a freight-passenger wreck. As the patient explained it, one of his " spells " (lapses of memory) had come on him while on the engine and he had passed a siding where his orders were to meet another train. An examination of his spinal fluid at this time showed a rapidly advancing process in his central nervous system apparently unaffected by the treatment he had received. We could find no evidence that the railroad employing this man had made any effort to identify a possible medical factor in his responsibility for the wreck. He was urged to give up railroad work but showed no inclination to do so and disappeared from observation before any further action could be taken.

Summary

1. A general medical examination of 1763 patients of the Mayo Clinic shows 3.1 per cent. of them to have syphilitic infections obvious enough to be detected without the use of the routine Wassermann test. Four and two-tenths per cent. of the men and 2.6 per cent. of the women have the disease.

2. The lowness of these figures reflects, to some extent, the weakness of clinical judgment in the recognition of this disease as compared with current figures based on the routine Wassermann test.

3. Part of the lowness of these figures is attributable to the large farming element in the clientele of the clinic and to the low incidence of venereal diseases in the states from which most of the patients are drawn.

4. Of the railroad employees examined, 11.7 per cent. had syphilis. The disease was eight times as frequent in them as in farmers (1.5 per cent.), three times as frequent in them as in business men (3.8 per cent.), and twice as frequent as in laborers (6.1 per cent.).

5. The doubtful value of the history of infection and the blood Wassermann test in the recognition of these cases is shown by the fact that 24 per cent. of the patients gave no history of infection other than gonorrhea; 62.5 per cent. had observed no secondary manifestations and 53 per cent. were completely Wassermann-negative on the blood.

6. On the other hand, 64 per cent. of those whose spinal fluids were examined showed positive findings.

7. Of the diagnoses, 58.7 per cent. were contributed by laboratory procedures; 41.3 per cent. were identified by routine physical examination.

8. Of the men examined, 79.5 per cent. had syphilis of the nervous system; 18.7 per cent. had cardiovascular syphilis.

9. Pupillary abnormalities, muscular paralyses and fundus changes were present in 62.5 per cent. of the cases.

10. Of the cases examined, 65.1 per cent. showed abnormal knee reflexes, and similarly high percentages prevailed for the other simpler details of the neurologic examination. Definite mental symptoms were present in 38.4 per cent.

11. The above findings suggest that the routine railroad medical examination is insufficient to protect the public from the

dangers of syphilis in men concerned in the operation of trains.

12. Three suggestions are made with a view to increasing the efficiency of the railroad medical examination with respect to the recognition of syphilis. First, routine Wassermann tests should be performed on all employees between the ages of 17 and 25, by a competent state Board of Health laboratory, and repeated on all employees reaching 32 years of age. Second, there should be annual effective examination of men between the ages of 25 and 40 rather than of men over 50. Such examinations should include more attention to pupillary reactions than is at present given, and should employ those fundamentals of the neurologic examination, such as tests of the deep reflexes, Romberg, etc. These can readily be performed by competent general examiners. Third, formal educational propaganda should be undertaken by railroad medical departments for the education of medical examiners and employees alike to the great significance of syphilis in industrial insufficiency and personal ill health.

Appendix

In the foregoing study the conclusions involving the characteristics of syphilis in railroad men are based upon a group of fifty patients. Previous experience with statistical groups of fifty based on our records had given us confidence in the accuracy of the results. When the paper was offered for publication, however, the editor of a journal of wide circulation declined it with the seemingly valid criticism that the number of cases was too small to make the deductions of more than minor importance. The authors then undertook to study the accuracy of their own work by carrying out another survey under identically the same conditions as the first. The second group of fifty railroad men, like the first, was taken at random from our files subsequent to a date after which reasonably complete examinations of all syphilitic patients were made. Every percentage estimate incorporated in the preceding paper was checked against the results in the second survey. The very striking parallelism of the results is apparent in Table 5 and will serve, we believe, as a confirmation of the accuracy of this type of work. By way of a critique on the belief that vast numbers of cases are essential to accurate conclusions in modern medicine, we submit the contention that the accuracy and completeness of the study of the individual cases made possible by modern diagnostic methods renders the indefinite multiplication of numbers of cases unnecessary. The purpose of numbers is to eliminate the inexactitudes inseparable from primitive work and unchecked observation. For every inexactitude which can be replaced by an exactitude the number of cases necessary to illustrate a point diminishes roughly in proportion to the increased

TABLE 5. — COMPARISON OF DUPLICATE SURVEYS OF TWO GROUPS OF FIFTY RAILROAD MEN EACH

General Data

The Preceding Article was based on the First Group. See Appendix

	First Series Per Cent.	Second Series Per Cent.
Cerebrospinal fluid positive	64	79
Lues, central nervous system	79.5	83
Lues III, cardiovascular	18.7	20
Blood Wassermann negative	57	58
Blood Wassermann positive	43	42
Wassermann weak positive	4	2
Use of alcohol	75	61
Heavy drinkers	36	33
History of lues II unobtainable	62.5	60
Lues recognized at some time	55	57
Age of onset late symptoms — over thirty	78	75
Gonorrheal history positive	80	73
Gonorrhea only	24	19
Symptoms appearing from six to twenty years after infection	71	67
Per cent. infected by the age of 32	91	81
Wassermann on men under 25 will reach	70	60
Sterile or pathologic marriages	44	50
Age on entry — patients between 35 and 40	32	36
Concerned in operation of trains	76	70
Concerned in operation of engines	36	36
Symptomatology		
Gastric	28	22
Not suggestive of lues	18	24
Headaches and head pains	16	16
Cardiac	14	16
Diplopia and poor vision	14	10
Malaise, weakness	12	8
Shooting pains	10	20
Bladder (subjective)	10	4
Nervousness	8	4
"Do I have syphilis?"	8	6
Laryngeal	8	6
Rheumatism	4	18
Ataxia (subjective)	4	6
Girdle pain	4	4
Dizziness	2	8
Objective Examination		
Abnormal knee reflexes	65.1	79
Abnormal Achilles	78.1	62
Romberg positive	38	42
Speech defect	15.7	17
Mental symptoms	38.4	38
Paresthesias	55.8	51.3
Ataxia (objective)	36.8	36.3
Bladder (objective)	47.5	20.5

accuracy afforded by the new test or method. While the diagnosis of syphilis has not by any means as yet been reduced to a mathematical problem, it is a pleasure to find that searching and painstaking study of a small group of cases by all known methods seems to yield results, the accuracy of which is equal if not superior to those of large series of cases subjected to less intensive investigation.

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THE PROPER EXECUTIVE FUNCTION OF THE INDUSTRIAL PHYSICIAN *

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AND

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LIKE almost all other phases of industrial relations, health work has imitated Topsy and "just growed." It is still, in most concerns, the baby of the family. And also it is often petted by its parents but kept distinctly "in its place," although this place has never been properly defined. Too many times it is a case of "being seen but not heard."

This unfortunate and anomalous position can, in large measure, be laid at the door of the industrial physicians themselves. They have never asserted their own rights positively enough, and it seems fair to suspect at least that they have never given their own work sufficient study to enable them to state the rights that should be equivalent to their responsibilities.

Let it be stated at the beginning that we believe heartily in industrial health work and feel it to be one of the major functions of industrial relations, on a par at least with employment, safety and service. In a paper before the National Association of Employment Managers, Mr. Kennedy endeavored to specify in some detail the way the general work should be divided among these four divisions. It is unnecessary to repeat this again — rather it is the purpose of this paper to go on from the point there left off, and to discuss the industrial physician both in relation to his work and more particularly to his position in conjunction with the employment manager, the safety engineer and the service director in the company. Moreover, in order that there may be no misunderstanding, it is necessary to add that the treatment here is functional and that these remarks apply with equal force in the large corporation where each phase of the work is handled by separate staffs and in the smaller company where all of it is practically centered in one or a few individuals.

What should be included in industrial health work? A great many people feel that it begins and ends with first aid and physical examinations. It may begin there but it has no just claim to its title if it ends there. Physical examinations are not so much justified by the over-theoretical objective of determining what job a man should properly be given — there is altogether too much nonsense about that — as they are by furnishing scientific facts on which a genuine program of health conservation can be based. Incidental to this program as well is the administration of first-aid dispensaries, of hospitals, of remedial work, of home nursing, of sick benefits or health insurance, of personal hygiene and of medical research. The last two are by far the most important and, unfortunately, by far the most neglected phases. In addition to these functions that come directly under his supervision, the industrial physician should co-operate in the fullest sense of the word with the employment manager in the effective placement of labor; with the safety engineer in the development and maintenance of proper sanitary conditions, and the handling of cases under the state workmen's compensation law; and with the service director in the provision of proper cafeteria service and prophylactic health education.

One can quibble on this division of work endlessly and a slightly different chart would be drawn by every individual now engaged in industrial relations work. In the long run, however, the quibbles do not affect the fundamentals nor do the organic charts amount to much more than a working plan that can be honored as well in the breach as in the observance. The important thing in the relations among these several heads of the work is less the sharp differentiation of their various functions than the clear understanding they each have of the value of the contribution of the others, and the willingness to work together in good-natured, hearty, spirited teamwork in their efforts to attain their common end.

It is unfortunately necessary to inject such easy-flowing platitudes, but it is nevertheless genuinely necessary. For what is hurting not only health work but all indus-

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trial relations work is the bigotry and the narrow-minded jealousies that too often affect the men engaged in it. There are many safety men, personnel directors, doctors, educators and welfare enthusiasts employed in industrial concerns whose efforts are mainly spent in attempting to convince the management, each that his own specialty is the hub of the whole problem, and that all the other lines of endeavor are merely auxiliary spokes between it and the outside rim that represents the workers. Nor is this attempt made only through strenuous and, in some measure, healthful, competitive rivalry. There has been painful backbiting, "passing the buck" and stealing of suggestions — familiar symptoms of organic disruption. And this occurs in the department dedicated to the promotion of industrial harmony and co-operative fellowship in production.

Of all those who are properly part of the directing staff of a department of industrial relations, the doctor is, by education and experience, the only genuine specialist and scientist. As such he is entitled not only to the respect due his knowledge, but also to a post of responsibility more truly equivalent to his capacity for service. Dignity is not mentioned here, although in many instances doctors sigh, pine and fight for it to the exclusion of all else. But the dignity that is inspired by good professional work will come to anyone if deserved. All other kinds are out of place everywhere and most particularly in industry.

Only in the larger plants, so far, is the doctor given any real responsibility or any real opportunity to perform his proper function. Even in some of the largest, as in most of the smaller concerns, the physician is regarded as a high-grade technical clerk and is subordinated in all executive activity to the employment manager, or personnel or service director, or a similar functionary under some other title. It is disheartening to see some of the medical departments in industries, many of which have been written up in trade and popular magazines as model centers of health work. The physical equipment is perhaps adequate — the white tables and cabinets, the glistening sterilizers and the shining instruments and tubes are impressive to the layman. But even the slightest investigation too often proves that all this equipment is more useful for impressing the visitor than for being of genuine prophylactic or even of remedial assistance to the workers.

This may seem an over-harsh indictment, but as a matter of fact it is not in reality an indictment at all. It is rather a frank statement of conditions that are all too prevalent, and that are due to the inadequate comprehension on the part of most employers and of many physicians of what industrial health work really is. To the employer the physical equipment looks satisfactory, though he may sigh whenever he regards the expense account. He senses vaguely though sincerely the value of a dispensary or physical examination room, and equips it with all the fandangos that warm his efficiency-loving heart. He gets a doctor — only occasionally through any real method of selection — sets mentally the financial limit, presses a buzzer marked "Health Work," and considers it done. The details of administration he very properly refuses to be bothered with — what's the doctor for? The statistical and scientific reports he files with only the scantiest review. The recommendations he considers, if at all, only in light of that financial limit.

Or he — Mr. Employer — goes to the other extreme and goes fad-crazy. "A dispensary! Let's go." "A dental clinic! Great; the best in the country." "Lectures on Sex Hygiene! Great idea; hold them in the plant rest rooms at noon and in every school and home in the city. What can't be charged to the business, I'll cover myself. Spare no expense, Doctor, and do this in a way we will be proud of and that our advertising department will approve."

This is no more overdrawn than was the previous criticism overharsh. But let us follow the health work down to its real lair and watch the department at work. Let us follow the line of applicants for employment. They are ushered into a waiting room and interviewed by the employment manager or his assistants. Those who survive are now commonly introduced to a little dressing room and told to prepare themselves for the physical examination. Their application cards or blanks are placed in a cubby hole in the door nearest the doctor, or are carried by the applicant. The amount of undressing required varies all the way from an opening of the shirt and undershirt to a complete stripping. Sometimes a shower bath is required. When his turn comes, the applicant is

ushered out of the other door of the dressing room into the examination room itself. His weight and height are noted; his chest is tapped; his heart and lungs stethoscoped and recorded. Occasionally cultures are taken, but very seldom is there time for this or for much else than the above. And very seldom indeed is there time — regardless of inclination — to explain to the applicant the truth of his condition, the meaning of the symbols placed on his card, or the purpose and method of work of the department. Most days are busy days and the desire to make the examination of educational and remedial benefit to the applicant must go by the boards in the endeavor to get him on the job at the earliest possible moment. If the physical condition requires rejection, the rejection is made without adequate explanation. If it demands later attention, it may be noted on the blank and even carried out at the right time, but little if any effort is made to explain the need to the applicant.

Of the adequacy of the examination itself, it is not for a layman to judge. But we should like to quote from a letter recently received from a friend who is one of the acknowledged leaders of industrial health work. He says:

> "I have come to the conclusion that industrial medical work is of comparatively little value in the way it is being done at this time. Take, for instance, physical examinations. They are being done today in all concerns in a haphazard manner. Because our forefathers in medicine listened to a chest by means of the stethoscope and percussed the lungs by tapping with the fingers, we in industry make our examinations in the same old method. It's just as possible, you know, that you might tie a string to the ceiling and if a man in passing blows it four feet to the left, he may be perfectly acceptable to industry; while, if it only goes three feet, six inches, he may not do at all."

Not even Bernard Shaw has been so sarcastic, and we leave it to the consciences of the medical men to decide whether it is justified or not. What is pertinent to this discussion here is that the whole question of industrial medicine is being challenged today by one of its own leaders, particularly on the basis of the methods in common usage. More serious, of course, is the effect of these methods on the workers. The letter that follows was actually received some time ago by the director of industrial relations in one of the largest companies in the country, and one that justly prides itself on its health work. The accusation as made is, to our knowledge, entirely unwarranted, but the mental reaction it portrays is very real, nevertheless. However, the letter speaks for itself.

> "In view of your kind compliance to my written request of recent date, I wish to thank you for your interest and to explain why I am not at present numbered among your employees.
>
> "I presented your letter of introduction at the Employment Bureau, from which point I was referred to 'The Society for the Prevention of Men Earning a Living.' After numerous sessions with different representatives of this honorable body, during which I imagined I was a candidate for the Diplomatic Service, I was finally herded into a 'pen,' presided over by a 'Physician' (don't know whether the title was real or imaginary). The Eminent Practitioner, after causing me to pose in the nude, subjected me to an examination similar to that imposed by a western Stock Buyer, when buying cattle on the hoof. After a series of evolutions the 'E. P.' discovered a disarrangement of my anatomy, which he said would effectually bar me from the service of the Company. 'Hernia upon the right side' was his verdict and I almost collapsed. I have since managed to secure mediocre employment with a local concern, where I hope to eke out an existence however miserable, until I am compelled to find asylum in a 'Home for the Physically Disabled,' or some such a benevolent institution.
>
> "Again thanking you personally for your favor, I am," etc.

This same reaction can be unearthed in almost every industry that has installed compulsory physical examinations. In lighter vein, there is the story of the West Virginian who every winter came down from his mountain farm and took up his work in a large mill in a not far distant city. There was never any trouble about his getting his old job back as he was strong, well and cheerful and a skilled worker. But the last time he applied, instead of being sent directly to the shop, he had to go through the ordeal of being interviewed, registered and examined. The process consumed over two hours and he was getting more perplexed and wrathy every minute. When he finally got to the dental chair and the dentist put the little mirror in his mouth, his patience could no longer withstand his vexation. Pushing the doctor's arm away, he got up and exploded

"Say, what the hell is all this? Do I have to bite the damned iron?" This story is old and has been repeated with many versions. But not only did it actually happen, but the wrath and perplex-

ity of this particular applicant is typical. More serious, of course, is the opposition of the American Federation of Labor to physical examinations. This is serious enough to make it a subject of resolutions at their annual congresses and to crystallize in the steel strike in a demand for their abolition.

Now what is really back of this? It is not ignorance nor any lack of enlightened interest in the welfare of the workers. As recently as August 15, 1918, Samuel Gompers is quoted in the official United States Bulletin as testifying that it was his opinion — speaking in his official capacity as President of the American Federation of Labor — that physical examinations of workingmen were necessary for the prevention of the spread of contagious diseases and for the protection of the man who might be placed at work for which he is physically incapable.

Moreover, in some of the garment trades physical examinations are being carried on by mutual agreement among the employers and the unions and at joint expense. The most noteworthy example of this is in the Joint Board of Sanitary Control of the Cloak and Suit Industry of New York. It must be said, however, that these examinations are not compulsory. And it is this compulsory feature of the examinations as much as, if not more than, their quality and manner of conduct that has alienated organized labor as well as many individual laborers. It is only human nature after all to resent and be suspicious of things we have to do — particularly if we are not given adequate reason for their necessity. As children we hate to brush our teeth or wash behind our ears, for the very good reason that we are made to regularly. As adults we are equally bitter about similar duties that devolve upon us, not so much from our own sense of their values or our own educated self-interest as from the fact that they are dictated by another.

Dictation is despotism, but it may be benevolent. But dictation without enlightenment is both stupid and tyrannous, a despotism that can never be benevolent since it automatically antagonizes those whom it aims to serve. Compulsory physical examination without effort to explain the purpose or the benefit to all is uplift rather than service and will in the long run be unavailing. Many, perhaps most, companies that have such a compulsory system have some descriptive booklet or house organ which purports to be a medium of interpretation to the workers of the ideals and purposes that lie behind the health work done by the management. But very few have learned the secret of simple and concise expression necessary for such interpretation or the knack of becoming accepted as a medium rather than as a bit of managerial — nay, even capitalistic — propaganda.

It is another case of "You know and I know, but the dog — does he know?" Too much health work is done more to impress boards of directors with their intelligent benevolence and to show off to fellow physicians the importance of the industrial doctor than to serve the workers and advance the standards of their health.

Again this is not an attack on the devoted doctors and nurses in industry. It is a criticism of the point of view that lies behind their work and the unfortunate limitations that are put in the way of their efforts. In order that such criticism may be more genuinely constructive, we must broaden the scope of our outlook and regard industrial health work, first in its relation to the community and then to the factors of production.

Everywhere in America today we are being faced with the necessity of a more vigorous, more rigorous campaign for public health. The campaigns against the fly, against infant mortality, against tuberculosis and against venereal disease have done much to arouse the public from its lethargy of ignorance and indifference to social disease. But the results of the military draft and of the influenza epidemic have more dramatically visualized the physical unfitness of our citizenry, and of our public authorities to combat disease and to hold steadfast our place as a healthful people. Both public and individual health have been held aloft in their full value by the war and have been impressively visioned by the whole people. Moreover, the cardinal primary lessons of hygiene and sanitation have been drilled into five million of our young men, and it is fair to hope that a great majority of these will in their turn become teachers of health.

Our governmental health agencies are still woefully lacking in resources, in power and in leadership. Here and there we find a community with sufficient social intelligence to develop a health department adequately equipped in all these essentials.

But, by and large, all three are missing and even when leadership asserts itself it is not given sufficient support to function.

Indirect attempts to remedy this situation have been made by the creation of privately supported community agencies, both institutional and non-institutional. While these have all the advantages of private initiative and efficiency, they have also all the disadvantages of private financing and philanthropic support. Yet in many centers, private dispensaries and clinics, visiting nurses' associations, hospital social service corps, and health centers are doing an enormous amount of good work, both in alleviating the sick and in spreading the gospel of prophylaxis.

Then there is industry. In many communities the manufacturing plant or plants determine and dominate both the existence and the structure of the social life. Moreover, it is in the factories that we have people brought together for production, thereby forming the most natural unit of effort looking toward their own well-being and that of the general public. The factories and the schools are the easiest and best centers through which the largest number of citizens can be reached and, therefore, become not only the most important strategic point in any campaign of general education but also the place where responsibility for such education and for remedial work becomes centered. On whom does this responsibility fall? It may be platitudinous to answer "On all of us," but nevertheless it is so. Industry, or rather the industrial organization, cannot shirk its responsibility in public health save by defying and neglecting its clear duty as an organic constituent member of the public — a group citizen of the community.

On whom within the industrial organization shall this responsibility fall? That is far less easy of answer. The same response is, of course, equally true but it sheds no light on the specific problem. The one thing clear is that those within the group who are financially and intellectually capable must assume this common responsibility as their own. In practical terms this involves the initiation and maintenance of organized health work by the management among the employees of the concerns. Rarely, indeed, has the industrial health department been organized from any such broad social motive but it is there, none the less, as the unconscious justification of all of them. What shall constitute the work of this department; how far it shall go in supplanting, subsidizing, co-operating with or surrendering to the social and public agencies, are matters that depend on the resources, the power and the leadership possessed by all these groups in the various communities. There is by no means sufficient knowledge or experience in this country as yet to make possible the standardized division of the field among them or uniform methods of practice. Industrial management should properly leave this to the judgment of the health expert engaged to direct the department. And — what is particularly pertinent to this paper — the "health expert" so engaged must be fully capable both in professional knowledge and social wisdom to study the problems and work for the answers. Whether or not the company shall install a hospital or contribute to an outside hospital; undertake home visiting or subsidize a social visiting nurses' association or develop public health nurses; provide a dental clinic within the plant or help the dental association to drive out the fakirs and make room for the honest private practitioner — all such questions are matters of local rather than general decision. But the point that is important here is that in this decision the industrial physician's social judgment and the intimate knowledge of the needs of the community must play a greater part than the philanthropic whim or over-zealous desire of the lay management. And, to repeat the primary fundamental indicated above, the industrial physician must be capable of acquiring that knowledge and formulating such judgments. Moreover, he must possess the quality of leadership sufficiently to convince his associates and employers of the soundness of his views. Please note that this quality of leadership is at the other extreme of character from that which attempts leadership through the assumption of dignity.

In the formulation of the health platform of the industrial relations program of the company, the health director then must be given full recognition and authority. Similarly, in the administration of that program, the health director must be given full leeway over the portion of it that affects health interests. He must be an executive in fact, in so far as judgment and decision are concerned. And that he may

be permitted full opportunity for his own work, he should be largely relieved of the executive direction of all those phases of the work that are routine or clerical by nature.

It has been often charged that physicians are too temperamental to make good executives. Controversies, bitter and prolonged, have raged over this point and there has been much heat, ill-feeling and a lot of mental blood spilling in the debate. Far be it from us as laymen to mix in with this argument, but common sense would seem to indicate that the whole question is of minor importance. The doctor as a professional man must not be required by industry or by anyone else to superintend the filing of cards, the tabulation of statistics or the attendance records of his subordinates. Too often this is what is meant by executive action. The health director in any plant, regardless of size, should be given competent clerical assistance for the checking of these essential but non-vital details. But the doctor as a professional man must be the one and the only one to read into these records and out of these statistics the hidden meanings of the cold facts they portray, and to interpret these meanings into social diagnosis and prognosis of conditions, and into recommendations for their treatment or elimination. That is technical executive work of the highest order and calls for the very best efforts of which the industrial physician is capable. Here he must reign supreme and his suggestions must be given full recognition and consideration — provided always, of course, that he is capable of judging wisely and recommending soundly. His conclusions and constructive suggestions must be reported fearlessly — not to the employment manager or safety engineer, but directly to the executive of the company in charge of industrial relations.

In making his reports thus fearlessly, the industrial physician has perhaps two distinct advantages over his lay associates who have authority co-ordinate to his. First, he treats with subjects from an angle that the executive acknowledgedly knows little if anything about, and can, therefore, command better attention. And secondly, his work is not so easily measurable in money or in units of production and it is, therefore, impossible to mark the value of his suggestions. However, these advantages are offset by the disadvantages that inevitably follow. The safety engineer may be able to get through a great improvement because he can show its value in dollars and cents. The service director or the employment manager can gain executive approval of his plans because he can demonstrate their value in increased efficiency or at least decreased waste. Health work can rarely be so easily evaluated as its effect on production, morale and saving is indirect and obscure. Moreover, in reality all reports of all those who are concerned with industrial relations should be fearless so that it is unnecessary to stress further this question of advantage. To the real man such advantage is of no interest, be he the doctor or not. And to the lazy or ineffectual type, it is of no avail.

The really able industrial physician will, by the very force of his interest and power of his knowledge, concern himself with every phase of industrial life that affects the health of the worker, and conversely with every health potentiality of the worker that will make him a better and more efficient contributor to industry. He will make his physical examinations and his clinical treatments mediums of prophylactic education of the individual and of protection of the community's welfare. He will investigate the sanitary conditions inside and outside of the factory and co-operate with all who will co-operate with him in their improvement. He will study the problems of hours in their relation to fatigue; of methods of operation in their psychopathic effect on efficiency; of compensation in its influence over mental and physiological well-being. Housing, social insurance, sanitation, dietetics, recreation, may not come under his province administratively, but he will regard them with his most earnest consideration as contributing factors to the health of his community clientele. From this enlightened point of view he will assist in the right placement of the worker, in the vocational training of and industrial opportunities for the handicapped; and will at all times endeavor to make his work and that of his lay associates a service which those for whom it is created will enthusiastically support and intelligently appreciate. He will run his department not by rules but by spirit. He will not confine himself to the four walls of his office or even to the gates of the factory yard. He will, on the other hand, consider his company as but a unit in the com-

munity and will tackle the social problems of the home, the school and the streets with a realization of their interdependency.

This is a large order, to be sure, and a rôle that can only be played by a real man. But what other type of man has any right to be an industrial physician? Industrial health work is a strategic keypoint in the whole campaign of preventive medicine. Only the real men — real in the depth of their professional knowledge and of their social vision — have any right to engage in it. Only such men can advance the cause of public health and only they can properly expect a real executive function in industry.

Granted this calibre of man and this scope of field, there is much that the industrial physician can contribute to industry. Nor is it by research alone that such contribution is to be made. No better vantage point for the instilling of good fellowship and the co-operative spirit can be imagined than the office of a real plant doctor. Physical examinations can be made the starting of a new interest in life and of a better understanding of physical law and social order. Clinical treatment, home visiting — even the granting of leave of absence for sickness — can be done in such a way as to win the complete confidence of the individual in the doctor and also in the company where they are both employed. Joint interest in health questions affecting the home and particularly the children is an excellent nucleus for joint interest and joint co-operative action in matters more vitally affecting the industrial relationship.

All these potential values make health work a very genuine factor in industrial relations and ensure to the physician in charge an executive position, limited mainly by his own capacity and leadership ability. He should not be superior or inferior in rank to those having charge of the other major lines of endeavor in this field. He should be given free scope within his own province and should be relieved of all responsibility over clerical routine, that he may devote his full energy to the task of studying all the problems affecting the health and thereby the efficiency of the industrial workers, and of drafting his recommendations and administering his approved plans so as to gain the conscious, intelligent support of his management, his associates and the employees at large. His executive function is so broad in scope and so rich in promise that it is to be hoped that the very best physicians will enter the field and give it the very best that is in them.

THE PREVENTION OF FATIGUE IN MANUFACTURING INDUSTRIES *

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THE productive capacity of manufacturing industries is in part a function of the physical, physiological and psychological conditions of the employees. This important fact has attracted more attention in the past three years than in the whole previous half century. The rationality and economy of long-time, physiological efficiency is gradually coming to be appreciated. Although systematic efforts have been made both in England and in America to analyze and study the problem of fatigue in industry, a practical, constructive program of prevention has thus far not appeared. The causes for this neglect are many. The main reason is that the problem is of such complexity that it cannot be approached successfully *solely* from the point of view of the mechanical or industrial engineer, the statistician, the industrial physician, the physiologist, the psychologist, the sociologist or the economist. In the following paper we have drawn freely upon the experience of others in attempting to point out certain fallacies and misconceptions that have crept into the fatigue literature. We then suggest what we believe to be a theoretically sound program of fatigue prophylaxis in industry.

In spite of the very considerable literature that has appeared in the past decade regarding the importance of "industrial fatigue," nowhere do we find an exact analysis either of the term or of the problem. The confusion and vagueness that now surround the whole question of fatigue in industry have resulted, in part, from an uncritical use of physiological terms by engineers and others with a modest equipment of physiological information. But the physiologists, themselves, have also been at fault. Believing that the problem of fatigue in industry would necessarily be illuminated by the application of exact scientific laboratory methods, a number of physiologists have entered upon the industrial field without a very clear preliminary analysis of just what they expected to measure. Armed with a group of relatively reliable *qualitative* tests, they have indeed succeeded in demonstrating fatigue in industrial workers. But this demonstration was, after all, not a particularly profound contribution; everyone knows that at the end of eight or nine or ten hours of labor a certain amount of fatigue (so-called normal fatigue) is inevitable. How tired a worker may become without endangering his health, i. e., where fatigue ceases to be normal and becomes cumulative, neither the physiologists nor anyone else has thus far succeeded in demonstrating. And this is precisely where three initial difficulties have appeared: (1) The laboratory tests for fatigue are, with one exception, *qualitative* and not *quantitative*; (2) the laboratory and statistical tests detect *normal fatigue*, from which one recovers over-night or over the week-end; (3) the detection and systematic prevention of cumulative fatigue, which leads to over-exhaustion and ultimately to a breakdown (industrial psychoneurosis) and which — being common to all industry — is the most widely distributed of all industrial hazards, have been largely neglected. (Spaeth, 1919.)

An illuminating illustration of the confusion of objective is furnished by a recent publication of the U. S. Public Health Service. Under *Ways of Detecting Fatigue*, the Divisional Committee on Industrial Fatigue (1918) states (page 6):

> "Everyone knows that a certain degree of fatigue is the normal result of bodily activity and is harmless. But it is not so generally recognized that the onset of over-fatigue may be greatly hastened, and that through it deleterious effects on both the worker and the plant may be caused by the conditions of work inside the factories, or by the occupation, habits and conditions of living of the workers outside the factories, or by both."

From the first sentence of this paragraph, we naturally conclude that normal fatigue is harmless; and the second sentence suggests in unmistakable terms that the real problem is that of "over-fatigue." But in the next paragraph we are told: "Fatigue may be detected by various tests, some of which have been studied so carefully and

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so improved that they can now be considered as fairly accurate and useful for practical purposes. Different methods are applicable to different cases."

Anyone who is familiar with these tests for fatigue realizes that the tests are for precisely the sort of fatigue which (in the words of the Commission) "everyone knows . . . is the normal result of bodily activity and is harmless." What physiologist or psychologist would claim that we have a variety of improved and carefully studied tests for "over-fatigue"? And yet the Commission admits that over-fatigue is the real problem. We may clarify the atmosphere at once by asking whether industry is interested more in the *detection* or the *prevention* of over-fatigue? And the answer we believe is that the industries are necessarily more interested in prevention, but would welcome any physiological or statistical tests that would really detect what they are trying to prevent. The problem seems to us to be, therefore, essentially that of over-fatigue prophylaxis.

I. The Unreliability of Output Tests

In a previous paper (Spaeth, 1919) we have discussed at some length the use of output statistics as a means of detecting fatigue. In its brief discussion of the use of output figures, the Commission is again, we believe, not entirely clear regarding the precise nature of the problem, i. e., the detection of *over-fatigue*. Its statements may apply to some cases of *normal* fatigue (see, however, Link, 1919) but are not necessarily valid in the case of incipient industrial psychoneurosis. The Commission states (p. 6): "A falling off in output when not explicable by other changes in the conditions of the work indicates fatigue." But we have pointed out that from purely theoretical considerations we might expect to find that "accumulative fatigue is often associated with a high output." (Spaeth, l. c., p. 15.) The output test would therefore not be applicable to such cases. Indeed, we may say that in cases of over-fatigue, if the condition is not discovered until the output drops, we are shutting the barn door on an empty stall. A practical illustration may clarify this point. In a recent survey of the working conditions in a large clothing factory we found one machine operator who seemed astonishingly dexterous and capable. Her efficiency, as calculated by the company standards, was constantly over 100 per cent. Nevertheless, when questioned by her foreman, this operator was found to be dreaming of her work, to feel that she could never get away from her machine, etc. In time this operator's output would almost certainly have dropped but, instead of waiting for such a contingency, she was promptly changed to another class of work. Now let us imagine what would have happened in this case if the operator had continued at her old job. The breaking point would have been indicated by a sharp fall in efficiency. She would probably have stuck at her machine for a time, but eventually she would have been forced to stop working — at least for a period. In the absence of sickness insurance, she would probably have been forced to return to her work prematurely, only to find that her former ability had apparently disappeared. A falling off of output under these circumstances would actually indicate over-fatigue of an advanced sort. But neither managers nor employees can be expected to be particularly interested in this sort of "test." They want to shut the barn door before the horse gets out. This type of waste, quite aside from the humanitarian aspects, represents an economic inefficiency which any employer will appreciate. Not only is there danger of permanently injuring and losing a highly efficient worker, but there is also the added economic burden of breaking in a new operator.

This single instance is but an illustration of a condition which we believe to be very common. Statistics are largely lacking, but an investigation of the hospital records in the Philadelphia garment industry upholds this view. Landis and Reed (1915) have summed up the evidence of pathological fatigue as shown in hospital and dispensary records as follows: (Evidences of Fatigue as Shown in Hospital and Dispensary Records, p. 91) "In addition to ailments which seemed to be attributable to the trade itself, it was found that muscle strain was complained of by seventy-eight of the 402 males and forty-seven of the 341 females intensively studied. Headache was noted among forty-three of the males and ninety-five of the females. The hospital records, already alluded to in a previous part of the report, also revealed some

interesting data relating to fatigue. The condition most frequently encountered was neurasthenia. After giving due allowance to the laxity which prevails in the use of this term, and the large percentage of Jews represented among the patients, it is a reasonable supposition that in a great many instances the diagnosis was correct if the term neurasthenia can be used to imply nervous exhaustion. The condition was noted as having occurred in 147 of 916 males (16.2 per cent.) and in 90 of 236 females (38.2 per cent.). It is more than likely that among those who complained from time to time of muscular strain, headache, etc., while at work, the condition, in many instances, developed into nervous exhaustion sufficiently marked to be designated neurasthenia. It is claimed by some that an occupational neurasthenia is not of infrequent occurrence, and that the nervous exhaustion can usually be shown to be due to some trade process. In many instances either the trade process, itself, predisposes to fatigue, or the conditions under which the work is done contribute largely to that end."

Thus the problem of applying individual output figures to detect fatigue appears to be complicated by at least two factors: (1) The fatigue that is detected may be either normal fatigue or advanced over-fatigue; (2) output figures, as ordinarily plotted, leave out of consideration all cases of over-fatigue that are associated with a *high* output. In extreme cases, over-fatigue that is indicated by a falling output selects workers who are physiologically burnt out and whose low efficiency will automatically drive them into the turnover. It seems, therefore, that the conclusions which the Commission has endorsed and recommended regarding the detection of fatigue by output figures cannot be accepted without important reservations.

FIG. 1. — A group of factory chairs and stools. Where operators are forced to sit for long periods the round-topped stools without backs should not be used. Specific criticisms will be found in the text.

II. FATIGUE IN RELATION TO THE WORKING ENVIRONMENT

In our discussion of normal fatigue, we emphasized the fact that no method has so far been discovered for determining at what point fatigue ceases to be normal and becomes cumulative. The most obvious and rational prophylactic measure is, therefore, the reduction of normal fatigue to a minimum. The simplest point of attack is the working environment. Throughout the

early years of the factory era in industry, human organisms were constrained to try to adapt themselves to a great variety of bizarre and unnatural conditions in the working environment. Only recently have workers and employers come to appreciate the economic and hygienic advantages of adapting the far more plastic environment to fit the needs of the human organism. We cannot here discuss the host of environmental factors that share in determining the normal fatigue of industrial workers. Some of these factors, such as illumination and ventilation, have already developed into highly specialized branches of engineering. Others have been quite as strikingly neglected—for example, factory seating facilities.

In their final report, the Health of Munition Workers Committee (1918) state: "The provision of seats and the use made of them unfortunately often appears to depend too much on the caprice or prejudices of individual managers and foremen, who do not yet realize that, if suitably used, seats reduce fatigue and do not encourage habits of idleness and slackness. Seats are particularly needed where the operations are long and cannot be accelerated, where waiting is apt to occur for material or assistance and where the two shift system is followed." It must be borne in mind, however, that the type of chair or stool has an important bearing on its usefulness. Surprisingly little intelligent interest has been shown in this connection and we have yet to discover a single industrial plant in which the problem of chairs and stools has been systematically studied. The long-legged, circular-topped stool, for example, is a physiological abomination. (Fig. 1, A.) The circular top, designed for convenience in manufacture and quite without regard for the form of the prospective occupant, is both hard and slippery. Workers often attempt to remedy these faults by covering the tops with cloth or leather (Fig. 1, E). A moment's consideration will make it clear that the higher we get from the floor, the more attention and energy we have to give to maintaining our balance. In the case of a high stool without back and arms the waste of energy becomes considerable. The types of defense reactions that are developed by workers who are forced to sit on high stools are most interesting. Some hook their feet about the table or stool legs; others arrange temporary foot-rests under the tables, using boxes or discarded chairs; still others wedge themselves tightly between the stool and table tops. A practical solution of this problem is either to scrap the old stools and install a simple type of saddle-seated stool with a back and foot-rest, or to convert the old stools into reasonably comfortable seats by screwing a broad seat and low back onto the old stool top. In general, stools and circular-topped bracket seats should be looked upon as transient appliances. Even a simple chair with a back is physiologically preferable. An ideal factory chair should have legs that are adjusted to tall and to short workers. The necessary adjustment can be made by blocking up or sawing off the legs. The seat should be broad enough to accommodate the largest workers and the back should be so attached as not to cramp or inconvenience the occupant. Figure 1, D, shows a common type of factory chair which is not suitable for large workers. (Fig. 2.) The next chair (Fig. 1, C) is an exceptionally good model, though not designed for factory work. It has an unusually broad saddle seat and a solidly braced back with the braces properly arranged so as not to interfere with the sitter.

In special processes where operators must sit on high chairs, foot-rests should always be provided. If the physical disposition of the work permits, it is an advantage to the operator to be able to work alternately sitting and standing.

The above observations on seating facilities could be paralleled in regard to much of the ordinary factory equipment. There is a large number of apparently trivial details of this sort, the improvement of which would contribute materially to the reduction of normal fatigue.

Rest Periods

One of the most rational and economical methods of reducing normal fatigue in industry is by the intelligent introduction of rest periods. Whenever an industrial process involves heavy work or work requiring constant standing or sitting, and especially when the task is repetitive and demands constant and close attention, rest periods should be introduced. Both the duration and the distribution of the rest periods must be determined experimentally for each individual process. It is well to begin

with a five-minute period in the middle of the morning and afternoon sessions. If production and quality are maintained or slightly improved, the rest periods can be lengthened by two-minute increments until the optimum condition is attained. In some cases better results are obtained by splitting up the total resting time into short periods distributed throughout the working spell. One can only suggest, not prophesy results.

"In America," we read in the Final Report of the Health of Munition Workers Committee (1918, p. 42), "much attention has been devoted to the proper length and distribution of pauses, and this is one of the most important aspects of 'scientific management.'" The experience of American manufacturers has recently been gathered in an important report of the National Industrial Conference Board (13, 1919). It is of special interest to note that the stimulus for collecting the American data was of *British* origin. "Recommendations of the British Health of Munition Workers Committee and other reports of favorable results from regular rest periods in British manufacturing establishments stimulated the interest of American employers and suggested the desirability of collecting and evaluating American experience in this field." The Board's study was carried on by means of a schedule of inquiry which was sent to 388 representative American industries. In sixty-seven manufacturing establishments employing 95,635 men and 40,930 women, 15 per cent. of the men and 63 per cent. of the women (approximately) were given rest periods varying from a single five-minute rest at 9:00 A.M. to twenty-five minute periods, morning and afternoon.

The American and British reports create the general impression that, in the first place, American and British manufacturers overestimate the frequency of rest periods in British and American industries, respectively, and in the second place, that rest periods could and should be far more generally used in the manufacturing industries throughout the world. The objections of piece-workers to what they fear will be the "lost time" of rest periods can usually be met by paying for the resting time at a base rate. The American Board reports one case of a hosiery factory where piece-workers are slowly "learning that a rest helps production." This is an ideal towards which the manufacturers may profitably strive.

FIG. 2.—This picture was taken in the finishing department of a garment factory in which scientific management methods had been installed. It illustrates a common and costly error in "scientifically" managed plants — standard time with unstandardized working conditions. Note that the chair is too small for the worker; that the woman is sitting with her back to the main source of light; that she sits beside uncovered steam pipes; that the rail of the table is worn too thin to support her foot; that, in the absence of a drawer in the table the worker must keep her necessary implements (pins, needles, etc.) in a cardboard box on top of the table and that she has pinned her hand-towel to the back of her chair. All of these unfavorable working conditions could be profitably remedied with a small expenditure of time and money.

It should be fully realized that rest periods are not universally necessary nor

helpful. Long, automatic machine processes—for example, such work as machine boring and cutting—provide intervals of respite for the operator which make extra rest periods superfluous, provided always that the operator has a chair (not a stool) where he can relax. In experimenting with the introduction of rest periods into a plant, it is most unfortunate when

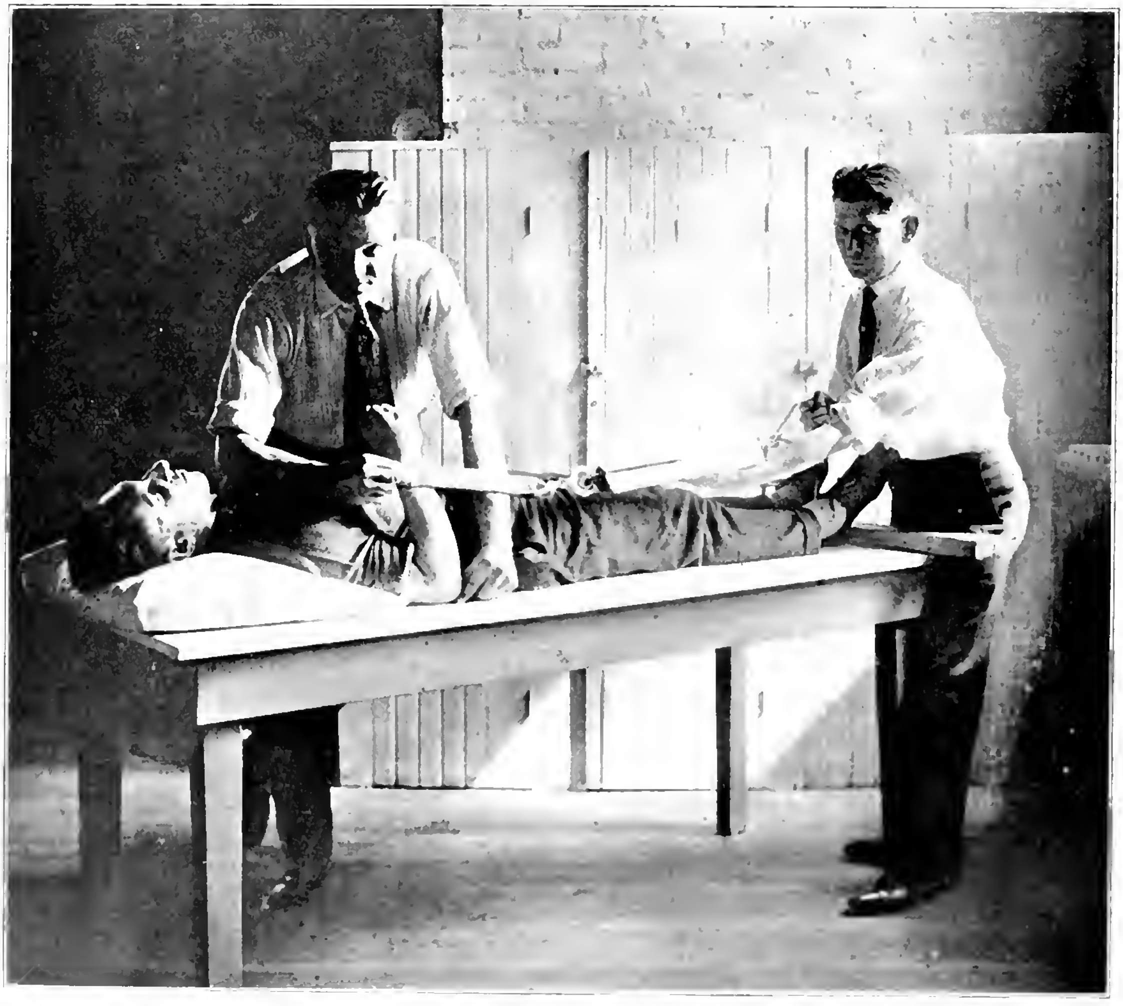

Fig. 3.—A group of skilled workers learning the technique of Martin's test in a garment factory. Note the foot brace on the table and the registering device attached to the spring balance for recording the pull of various muscles. The spring balance is designed according to Martin's description.

this type of process happens to be selected for experimentation: the whole idea of rest periods may be discredited by its inapplicability to a particular case. The general confusion and noise that break out spontaneously during the rest periods frequently appear to worry the management at first into the fear that discipline is hopelessly and permanently ruined. The tendency to make use of the toilets and drinking facilities during rest periods should not be interpreted as lax discipline but rather as an encouraging sign of the cultivation of regular habits among the employees.

III. Reduction of Necessary Fatigue

We have drawn attention above to the fact that no one can complete even a moderately strenuous industrial day's work without becoming more or less fatigued. *Some* fatigue is necessary. It is this fatigue which we call the "necessary fatigue" of a given job. But the amount of this necessary fatigue may be reduced. For, once the working conditions are standardized, the necessary fatigue of a job varies with the physical, physiological and psychological peculiarities—the fitness—of the

individual workers. In order to reduce to a minimum the necessary fatigue, the workers must therefore be selected by a carefully worked out system of physiological classification. In making the classification of employees, the data may be arranged under the following four captions:

1. *Physical Strength.*—First of all, if the job in question requires a considerable amount of muscular exertion—and a vast number of industrial jobs do—the workers should be tested for total muscular strength. Nearly all the older and familiar forms of dynamometers are either theoretically unsound or fail to give the desired information. Dr. E. G. Martin's spring balance technique has, however, met both of these objections in a most satisfactory fashion. Not only is the routine of Martin's test extremely simple, but it has the additional advantage of involving an inexpensive and easily procurable piece of apparatus. We have found that two intelligent workmen can, with very little practice, be taught to carry out Martin's test with speed and accuracy. (Fig. 3.) Furthermore, this test has the advantage of being carried out on both men and women with the subjects fully clothed. Finally, Martin's test has already been used both in measuring the physical strength of soldiers and in estimating the capacity of a variety of classes of industrial workers. (Martin, 1918, a and b; Martin and Rich, 1918.)

In Martin's test the pull of eight important muscle groups is registered in pounds on the spring balance, and the result, when multiplied by the factor, 6.67, gives an accurate index of the total body strength. For the exact details of the test, Martin's original papers should be consulted. In the case of very heavy work such as that in a foundry, for example, a better figure for physical capacity is given by the $\frac{\text{strength}}{\text{weight}}$ ratio. Whenever weight figures are available and the strength test has been carried out, the $\frac{S}{W}$ ratio should obviously be calculated and recorded. The possible correlation of this ratio with other physiological values cannot be predicted beforehand.

The exact purpose and significance of the strength test may best be brought out by a practical illustration. Suppose we have twenty-six operators, all engaged in carrying on the same heavy, machine process. The output of these operators, in the absence of any voluntary restriction, will vary from man to man. The total strength (or $\frac{S}{W}$ ratio) will likewise vary; but by testing all twenty-six men we arrive at an empirically determined limit of strength for this particular operation. Let us assume that the weakest man pulls 3200 pounds. If, now, our figures show a consistent correlation between low output (or other criterion of lack of success at the job) and low strength or a low $\frac{S}{W}$ value, we already have information which will be of use in placing future applicants for this particular job. Any man who falls below our empirically established "minimum strength" figure need not necessarily be denied his chance at the job, but he should be put on, at first, only for a preliminary trial. The validity of the original minimum strength figure will gradually become established. At the outset we will probably find, especially where our total number is small, that our minimum strength is too high. Satisfactory operators will appear from time to time who fall below our minimum figure. But as time goes on we shall gradually reach a figure which becomes increasingly reliable, having been tested empirically by an increasing number of cases. When this end is attained, we shall have a means of reducing necessary fatigue by allowing only those operators who fall within our strength limit to remain on the job indefinitely.

A number of objections to the simplicity of our conclusion must occur to anyone who has had experience with the bewildering number of variables that appear even under relatively uniform industrial conditions. First of all, the strength test might be imagined to be of little practical significance in industries where the style of the manufactured products is continually changing. This criticism is only partially justified. For, in the clothing and garment trades, for example, where styles vary continually, the energy expenditure on the heavier jobs (pressing, hand-finishing of heavy coats, etc.) remains relatively constant. We feel, however, that the strength test would be of particular significance in industries where the product is uniform. A second outstanding objection is the high probability that we should fail to discover any considerable correlation between strength (or

$\frac{S}{W}$) and output, or other sign of success at a particular job. Obviously we are not in a position to guarantee results. In cases where there is no correlation between success and strength, we must turn to the more subtle physiological and psychological tests for enlightenment. Finally, the objection that all physical and physiological tests are looked upon with suspicion by employees must be met by a vigorous explanation as to the prophylactic purpose of this test and those that follow. In our own experience we have found that, among English-speaking workers of average intelligence, such suspicion quickly disappears once the men and women understand that the tests are only intended as a sort of health insurance and a protection against over-exertion and permanent disability. Suspicion among industrial workers as to the object of physical examinations has frequently been well founded where physical unfitness has been used as an excuse for getting rid of union members or other blacklisted employees. Among the less intelligent or among foreign workers who fail to grasp the meaning of an explanation, there is frequently a deep-seated suspicion of anything remotely connected with physicians, nurses, hospitals, clinics, etc. In other cases the workers feel that there is something degrading about a physical examination, that such examinations should be limited to horses and cattle, etc. These conditions really present a fundamental problem in education and they must be treated as such — not as insuperable objections to the use of physical and physiological methods in industry.

2. *Physiological Efficiency.* It is a familiar fact that a sudden expenditure of energy, such as running upstairs or lifting a heavy weight, will cause a change of pulse rate and variations in blood pressure. These changes constitute physiological compensations. The success with which the human body can compensate for a sudden output of energy or change of position is a fair measure of the body's physiological efficiency. Physiological compensations may be indicated simply by a change in posture. Thus, in a normally strong and vigorous subject, there is a rise in blood pressure of about 10 mm. of mercury when changing from a reclining to a standing position. This change in blood pressure is brought about by an increase in the splanchnic vaso-tone. According to Dr. C. W. Crampton (1915): "In an individual weakened by dissipation, overwork, lack of sleep, or by the incidence of disease, the blood pressure will tend not to rise but to fall." Crampton also found that the heart rate of a vigorous subject did not increase upon arising from a reclining position, but "in the wearied subject it increased as much as forty-four beats per minute." This increase "varied with the blood-pressure differences and in some cases took the place of the blood-pressure variation. In other words, the same subject under the same conditions would show a weakness, sometimes by a decrease in blood pressure, and at other times by an increase in heart rate, and vice versa." By means of a simple tabular scheme, Dr. Crampton has devised a percentage scale for estimating physiological "efficiency of the body" as shown in Table 1.

TABLE 1. — PHYSIOLOGICAL EFFICIENCY RATING ACCORDING TO CRAMPTON

Heart Rate Increase	Blood Pressure: Increase						Decrease				
	10	8	6	4	2	0	2	4	6	8	10
0–4	100	95	90	85	80	75	70	65	60	55	50
5–8	95	90	85	80	75	70	65	60	55	50	45
9–12	90	85	80	75	70	65	60	55	50	45	40
13–16	85	80	75	70	65	60	55	50	45	40	35
17–20	80	75	70	65	60	55	50	45	40	35	50
21–24	75	70	65	60	55	50	45	40	35	30	25
25–28	70	65	60	55	50	45	40	35	30	25	20
29–32	65	60	55	50	45	40	35	30	25	20	15
33–36	60	55	50	45	40	35	30	25	20	15	10
37–40	55	50	45	40	35	30	25	20	15	10	5
41–44	50	45	40	35	30	25	20	15	10	5	0

NOTE. — In case of increase in pressure higher than 10, add 5 per cent. to the 10 column for each 2 millimeters in excess of 10.

The 100 per cent. rating indicates a rise of 10 in pressure with practically no increase in the heart rate. Through the table, inefficiency exhibited either in blood pressure or in heart rate is given a corresponding lower rating until zero is reached. The zero point indicates approximately the condition in which the vaso-tone system is working so poorly that the subject cannot maintain an erect position.

As in Martin's strength test, Crampton's physiological efficiency test has been subjected to considerable practical trial — in this case, by the New York State Commission on Ventilation. We believe that Crampton's test could be applied in industry, quite as we suggested for Martin's test. At the time of examination for physical strength, the blood pressure and

pulse reading could easily be made, preferably just before Martin's test is begun. In this case the limits of *physiological efficiency* necessary for various jobs should be empirically determined. This procedure would give us a second standard for estimating the fitness of an applicant for a particular job. Furthermore, we could now determine to what extent — if any — physical strength ($\frac{S}{W}$ ratio) is correlated with physiological efficiency and success at any specific industrial operation. Again, we cannot predict with certainty that any significant correlation would be found; but in view of the fundamental physiological importance of the functions measured, it is reasonable to expect that some such correlation exists.

3. *Endurance.* We have at present no method for determining in advance how successfully an individual may be expected to stand the strain of his job over long intervals of time. We must therefore resort to the individual medical histories for information regarding serious illnesses, surgical operations including pregnancies, specific diatheses and any pathological conditions which might be expected to affect endurance directly. Endurance *may* be associated with successful physiological compensation. This question could be answered by a careful, comparative, statistical study of the industrial records of long-time employees.

American industrial conditions are so complex and varied that the physiological standardization of industrial workers in universal terms becomes meaningless. Empirical standardization by industries and processes, however, seems to us to be logical, necessary and practical as a health-insurance measure. Heretofore, industrial physicians have been so occupied with special problems in the pathology of industry that little progress has been made toward the systematic elimination of preventable fatigue among industrial workers. Even an approximate solution of the question can scarcely be expected if we limit our observations to the purely physical and physiological aspects of the problem. There are certain fundamental psychological and psychopathic phenomena which must be taken into consideration. Space and ignorance forbid our giving more than a few suggestions in this connection.

4. *Intelligence and Trade Tests.* — The work of the Division of Psychology, Medical Department, U. S. Army, has shown the extent to which the general intelligence of men may be approximately determined by well thought out psychological tests. (Army Mental Tests, 1918.) The psychological division has also shown that it is practical to give intelligence tests to large groups of men with considerable dispatch. The army intelligence tests cover such a broad range of general information that we believe they could be given to industrial workmen with few or no changes. For women the tests would have to be modified as regards specific questions; but the general plan of the tests could profitably be followed in arranging new papers for industrial workwomen.

As in the physical and physiological tests, the intelligence test (original or modified) should be given to all employees in a given department. This procedure would have the twofold advantage of exposing any hitherto unappreciated high order of intelligence, and, at the same time, the results would establish an empirical standard (as in the physical and physiological tests) by which future applicants could be roughly classified. Men who have served as privates in the army and who have been put through the army intelligence tests should present their intelligence "score" when applying for a job. This simple precaution would keep many a discharged soldier on his job. For men are often carried into the labor turnover by a feeling of hopeless inadequacy or hopeless superiority to the job in hand. Whereas a high score (A or B) in the army or in a similar intelligence test is a significant index of mental development, failure to pass either the literate or illiterate test does not necessarily mean that the subject is hopelessly stupid. In such cases individual examinations should be given. Thoughtfully worked out preliminary exploratory tests help to orient men more satisfactorily and certainly than can be done by the most well-meaning but unscientific employment manager. The rehabilitation and prevention of industrial misfits is one of the most important phases of industrial psychology. This problem is closely associated with fatigue prophylaxis. We may safely assume that the industrial misfit is among the first to succumb to the pace of an intensive occupation and to develop a condition of physical and mental

over-exhaustion which is variously diagnosed as neurasthenia, depression or industrial psychoneurosis.

There are obviously many processes in industry in which some sort of intelligently devised dexterity, co-ordination or trade test might give a valuable index of actual and potential success at a given job. Here the laboratory psychologist encounters an entirely novel group of circumstances. For, unlike his theoretical experimentation with trained students, the practical success of an industrial test depends in large measure on the attitude of the subjects. If the subjects are asked to perform any tests involving the use of elaborate (and terrifying) psychological apparatus, the chances are that a comparison of experiences will be made after working hours and that the tests will, by mutual agreement, be pronounced "high-brow" and meaningless, if not actually futile and exasperating. This attitude on the part of the workers may go so far as to injure the reputation of a plant; a firm that is known to put its employees through a series of mysterious stunts before letting them go to work may easily become an object of suspicion. The difficulty may be met by devising tests in which familiar materials — pins, needles, buttons and cloth in the garment trades, for example — are used. Valuable information regarding ability to follow directions and manual dexterity could be obtained by requiring buttons of a certain color or size to be sewn on a given piece of cloth according to some simple pattern. In practice, a group of manifestly skilled workers should be selected on the basis of the recommendation of their foreman or their output records. *In making this selection it is important to eliminate any individuals who are known to be emotionally unstable.* Output, in such cases, is a dangerous criterion of success. An appropriate group of workers having been chosen, they should be given a series of, say, six different tests. After the customary corrections for errors in reading directions and speed of performance have been made, it will be possible to discover which of the six tests correlates most highly with demonstrated skill. This test should then be selected as the one to be given future applicants for the job in question. The more numerous the tests, the more trustworthy will be the result.

The general principles which we have advocated as a means of preventing fatigue in industry are identical in all cases. The only assumption that we make is that an individual's success as a worker is not entirely independent of his physical strength, physiological efficiency, intelligence and skill. No further generalization is possible without actual field data.

The Limitations of Scientific Management

In presenting the labor claims of scientific management before the United States Commission on Industrial Relations Frederick W. Taylor assumed the following position regarding the questions of overspeeding, fatigue and exhaustion.

> "1. Scientific management guards the workers against overspeeding and exhaustion, nervously and physically.
>
> "(*a*) By substituting exact knowledge for guesswork in the setting of the task.
>
> . . . .
>
> "(*e*) By training the men in the easiest methods of work.
>
> "(*f*) By careful studies of fatigue and the setting of the task on the basis of a large number of performances by men of different capacities and with due scientific allowance for the human factor and legitimate delays.
>
> "The so-called speeding-up of scientific management is, in the main, a speeding-up of machinery, requiring no extra exertion on the part of the workers. The speed of the men is determined by psychological and physical tests, and is always set with reference to long-time results. Scientific management challenges anyone to show any overstrained or overworked man in the scientific management shop." (Hoxie, 1918, p. 144.)

In all the purely mechanical phases of task setting, exact knowledge should by all means be substituted for guesswork. No job should be begun without having adequate tools and machinery properly sharpened and oiled, the speeds and depths of machine cuts worked out and given for various kinds of metals in accordance with Taylor's own brilliant mechanical researches. The advantages of using mathematically calculated optimal values are too obvious to require discussion. So long as scientific management confines itself to the improvement of machinery and to the standardization and perfection of working equipment, neither organized labor nor any other group or individual can have any serious quarrel with it. When, however, we consider the physiological aspects of

scientific management, we find a striking disparity between the claims made by Taylor and his followers and the actual results in practice. By physiological aspect we mean the practice of making time and motion studies on certain individuals in order to establish a standard time and standard method for doing a particular job.

Time Study and Task Setting

The process of time study is believed by the advocates of scientific management to produce an objective scientific result. The scientific accuracy and justice of the established time are not open to dispute, according to Taylor; nor is this time a subject of bargaining, since the time study technique "substitutes exact knowledge for prejudiced opinion in the setting of the task." As a matter of fact, with the possible exception of machine jobs in which the human element is practically negligible, i. e., where the speed is a question of machine capacity, and where overspeeding of the worker beyond the machine speed is a physical impossibility, the results of time study depend in a large measure on the judgment and prejudice of the time-study man. The difficulties encountered by the time-study man in arriving at the "proper" time have been analyzed by Hoxie (1918, p. 46) as follows:

"The time study process includes a score of factors variable with the judgment and will of those immediately concerned, variation in any or all of which acts as a determinant of the task. This is made evident by a careful analysis of the process. Such analysis shows that among the factors that may thus vary, subject to human will, are: (1) The general attitude, ideals and purposes of the management and the consequent general instructions given to the time study man; (2) The character, intelligence, training and ideals of the time study man; (3) The degree to which the job to be timed and all its appurtenances have been studied and standardized looking to uniform conditions in its performance for all the workers; (4) The amount of change thus made from old methods and conditions of performance, e. g., the order of performance, the motions eliminated and the degree of habituation of the workers to the old and the new situation when the task is set; (5) The mode of selection of the workers to be timed and their speed and skill relative to the other members of the group; (6) The relative number of workers timed and the number of readings considered sufficient to secure the result desired; (7) The atmospheric conditions, time of day, time of year, the mental and physical condition of the workers when timed and the judgment exercised in reducing these matters to the 'normal'; (8) The character and amount of special instruction and special training given the selected workers before timing them; (9) The instructions given to them by the time study man as to care and speed, etc., to be maintained during the timing process; (10) The attitude of the time study man toward the workers being timed and the secret motives and aims of the workers themselves; (11) The judgment of the time study man as to the pace maintained under timing relative to the 'proper,' 'normal' or maximum speed which should be demanded; (12) The checks on the actual results used by the time study man in this connection; (13) The method and mechanism used for observing and recording times and the degree of accuracy with which actual results are caught and put down; (14) The judgment exercised by the time study man in respect to the retention or elimination of possibly inaccurate or 'abnormally' high or low readings; (15) The method used in summing up the elementary time; (16) The method employed in determining how much should be added to the 'necessary time' as a human allowance; and (17) The method of determining the 'machine allowances.'"

It seems perfectly clear, therefore, that the objective scientific character of a "proper time" simply does not exist. A result that is attained partly by extremely accurate measurements of short-time intervals and partly by the flipping of an imaginary coin by the time-study man can only be as accurate as the *least* exact step in the process. The average time-study case is quite comparable to an attempt to measure electrical conductivity to four decimals of reciprocal ohms without any accurate means of measuring the temperature of the system. If the experimenter must trust his own judgment in the matter of temperature, then his final result depends on how good a guesser he is. Similarly with the time-study man. The reliability of his standard time depends not so much on the accuracy of his time readings as it does on how well he can guess at the fatigue allowance and other unmeasured variables. One great mistake in the present methods of making time studies lies in the dependence upon *performance alone*, without any consistent attempt to correlate performance with the physiological and psychological peculiarities of individual workmen. The importance of this correlation may have been appreciated by Taylor but has been neglected by his followers practically without exception. Even in Taylor's original description of his experiments with

Schmidt, the pig-iron handler, no accurate account of the man's physical strength, weight or other characteristics is given. To the industrial worker, the speed at which he has to work in order to get a certain wage is the most salient feature in scientific management. And the time-study man determines that speed. Hence the time-study man, from labor's point of view, becomes the keystone of the whole structure of scientific management. Considering the importance of his position, we might expect the average time-study man to be a highly trained technical and industrial expert with a profound and sympathetic understanding of the workers. In addition, Hoxie believed that he should "be able to recognize and measure nervous disturbance and fatigue and understand and deal wisely with temperament." (Hoxie, 1918, p. 55.) On the basis of Taylor's own claims this is not an unreasonable demand. As a matter of fact, we have seen above that the measurement of nervous disturbance and fatigue has not yet been satisfactorily accomplished by the psychologists and physiologists. To expect time-study men to be able to make adequate and wise allowance for nervous disturbance and fatigue is therefore over-optimistic, to say the least. In summing up his own experience with time-study men, Hoxie says (l. c., p. 55):

"The best men in this work are perhaps technically qualified, but, so far as the observation of the writer has gone, the best of them are technicians with little knowledge of the subject of fatigue, little understanding of psychology and temperament, little understanding of the viewpoint and problems of the workers, and almost altogether lacking in knowledge of and interest in the broader economic and social aspects of working-class welfare. The bulk of the time study men encountered were immature men drawn from the shop or from college. They were expected to get their knowledge and training in all matters enumerated above through the actual work of time study and task setting. In the majority of cases encountered, it was not considered essential that they should have had any special training in the particular industry. A man who had worked exclusively in the machine shop was considered competent after a few weeks or months of contact and trial experience to set tasks in a cotton mill. Sometimes previous industrial experience of any kind was not considered necessary. Analytical ability, good powers of observation, a sense of justice and tact were the chief qualities emphasized as essential for a good time study man. Rarely, if ever, was anything said of technical knowledge concerning fatigue, psychology, sanitation, safety, and the broader problems of industrial and social welfare."

Do Motion Studies Reduce Fatigue?

It is frequently claimed both by efficiency engineers and by physiologists that by omitting unnecessary motions in a given process fatigue may be reduced. Thus, Spooner (1917, p. 8) states: "By suitable camera work most manipulative operations can be simplified and improved in such a way as to reduce fatigue at the same time." Now if but a single performance of a process is considered, there is obviously less fatigue when unnecessary motions are omitted. For one performance fatigue is a function of the number, extent and speed of the motions. But when we recall that with fewer motions an individual will perform the process far oftener in a single day, there is no reason to suppose that the total fatigue at the close of the day will necessarily be reduced by the improved method. The aim of motion study and motion elimination has been primarily *output*, i. e., increased production. Greater production means increased wages and profits, hence "improved methods find favor in the eyes of both employees and management." Whether the fatigue at the end of a day or week is greater under the old or the new method is rarely asked. There is, however, no scientific basis for believing that an individual's physiological efficiency will necessarily be greater when carrying out an "improved" process. By reducing the number of motions in a given operation we increase the chance of making that process monotonous. And it is probably true, though we have no statistical proof at hand, that the more the motions are simplified, the greater becomes the danger of monotony. The exact relation between monotony and fatigue is again an extremely complicated question to which there is no universally valid quantitative answer. We may, however, meet the danger of decreased efficiency (immediate and long-time) resulting from both monotony and fatigue by the intelligent introduction of rest periods. Only by so doing is it possible for both management and operators to reap the fullest benefits of an improved process.

The normal fatigue of a day's work is, therefore, *not* reduced by eliminating superfluous motions alone, but, coupled with rest periods, an improved process may spare both the company's time and the employee's health. Without rest periods, the

probability of speeding-up with an improved process becomes a moral certainty.

We may summarize our conclusions regarding the limitations of scientific management as follows:

1. The practice of time study and task setting is, in general, highly unscientific in that it depends not upon an objective scientific fact but in large measure upon the judgment of the time-study man.
2. The danger of entrusting the health of workers to the judgment of youthful and inexperienced time-study men is not sufficiently recognized by scientific managers.
3. Systematic attempts to measure the fatigue of a given job or to place workers on the basis of any scientific, physiological or psychological tests or standards are lacking.
4. The importance of long-time performance and physiological efficiency in task setting is not appreciated by time-study men and industrial engineers.
5. The necessarily intimate relation between motion studies and rest periods is often lost sight of in the desire of the efficiency expert to increase production, and the desire of the workers to make higher wages.

Summary of General Conclusions

1. The absence of a critical preliminary analysis has led to a confusion in the minds of certain physiologists between normal fatigue in industry ("industrial fatigue"), which is harmless, and cumulative fatigue, which is dangerous and may be associated with serious nervous disorders (industrial psychoneuroses).
2. So far as we are aware there exists at present no valid quantitative physiological test for cumulative fatigue.
3. Since normal fatigue may merge insensibly into cumulative fatigue, the reduction of normal fatigue to a minimum is the first logical step in a prophylactic attack.
4. Normal fatigue may be reduced by a careful adaptation of all environmental factors such as illumination, ventilation, humidity, temperature, disposition of machinery, seating facilities, periods of rest, adequate and nutritious food, etc., to the physiological requirements of the workers.
5. There is a great need for physical, physiological and psychological standardization of industrial workers by trades and processes. We have suggested a number of simple tests or types of tests that could be applied in a large variety of industries. Such tests are important for adolescents from 14 to 20 years of age as well as for men and women in industry.
6. A number of physiological shortcomings of scientific management are discussed, especially the untrained type of time-study man and certain highly unscientific aspects of time and motion study methods.

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ORGANIZING AN INDUSTRY TO COMBAT INFLUENZA *

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THE epidemic of influenza, which spread over the whole United States in 1918, first made its appearance in Boston. The earliest recorded cases arrived on an army transport late in the month of August. These few typical cases were taken to the Chelsea Naval Hospital, where other cases were soon reported from among the 5000 sailors then on duty at Commonwealth Pier, about half of whom were quartered among the civil population of greater Boston. The presence of the disease was not generally known, however, nor was its seriousness realized until about the second week in September, when an emergency hospital was established for the men in the training division of the U. S. Shipping Board.

At that time the writer was the Sanitary Engineer for District No. 1 of the Emergency Fleet Corporation, charged with the duties of an industrial hygienist for the twenty shipyards located between Groton, Connecticut, and Eastport, Maine. The yards in question employed a total of about 40,000 men and varied in size from yards constructing wooden ships and having only 150 men to the Fore River Steel Shipyard of the Bethlehem Steel Corporation at Quincy, which employed 15,000 men.

Our first knowledge of the existence of the disease in Boston was obtained on September 10. There were already many cases in greater Boston and the disease was spreading rapidly as is shown by the fact that the important period of the epidemic in this district was from September 15 to November 1. Late as was our warning, it was possible to institute precautionary measures in all yards before the epidemic reached them. To do this it was necessary to begin with those nearest Boston and to act immediately without awaiting orders from the officer in charge of the Division of Health and Sanitation located at Philadelphia. A complete record of activities, however, was wired for confirmation and approval.

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The following is a brief statement of the general program carried out:

1. The general manager of each plant was warned by telephone or telegraphic communication of the danger which threatened his organization. This communication was followed by a confirming letter outlining the situation and the steps needed for its control.

2. The industrial physician in each plant was given all the available facts regarding the nature of the disease, its treatment, the clinical appearance of the cases already under treatment in Boston and the advisability of prompt isolation and bedside precautions.

3. A special co-operating organization was created in each yard consisting of:

(*a*) The physician and nurse at the first-aid rooms; (*b*) an assistant to the physician, where necessary, who attended to non-medical details; and (*c*) the foremen in the yard, who were instructed by means of printed directions prepared by the sanitary engineer and distributed with the added authority of the yard management. These instructions, which were telegraphed to the yard management, outlined the symptoms of the disease and stated the necessity of sending immediately all men with such symptoms to the plant physician or nurse.

The following is the message placed in the hands of foremen at the Groton Iron Works: "Influenza spreading from Boston. Sure to reach Groton. Symptoms: coughing, sneezing, headache, fever, general soreness. Some cases sure to appear in shipyard. We must prevent spread to other men. Ask you to help by watching men under you and sending any men with symptoms to yard hospital immediately. Work quietly, do not alarm men." This statement was signed by the sanitary engineer and endorsed by the yard management.

4. The co-operation of the local, state and federal public health agencies was secured and it was arranged that they

should receive prompt reports of all cases occurring in the industry. Such co-operation used to the best advantage the medical and nursing personnel of both the industry and the health agencies.

5. Posters or signs prepared at the yard warning against special dangers of infection were posted near the gates where employees entered and left. The following copy was used for most of these posters:

"IF YOU HAVE COLD OR GRIPPE REPORT TO DOCTOR IMMEDIATELY.

BEWARE OF ANY MEN COUGHING OR SNEEZING.

WHEN YOU COUGH COVER MOUTH WITH HAND.

AVOID PUBLIC GATHERINGS — THEATRES — DANCES — ETC.

DO NOT SPIT ON MATERIAL THAT MUST BE HANDLED.

GET GOOD FOOD AND ENOUGH SLEEP."

6. Hospital and treatment facilities were arranged for in advance of the actual appearance of cases. These treatment organizations consisted of medical, nursing and volunteer personnel in the larger yards. In most cases, some barrack or other building on the shipyard property was transformed into an emergency hospital.

7. The use of common drinking cups was immediately discontinued in all yards and individual paper drinking cups with special sanitary distributing buckets were supplied where sanitary drinking fountains were not available.

8. The complete scalding of all dishes in restaurants, hotels and barracks was required.

9. Special supervision over food handlers was instituted, with examinations twice daily, in order that no person handling food for shipyard workers should continue work with the slightest symptoms of the disease.

10. Educational pamphlets upon the subject of influenza were distributed to men in all yards.

11. Influenza vaccine was supplied to all doctors and nurses who desired to use it.

12. Daily reports from each yard were received at the Boston office, indicating the number of cases appearing at the yard hospital during the preceding twenty-four hours. These reports were upon special forms prepared at the office of the sanitary engineer with the aid of a neostyle machine. Such reports made it possible for the sanitary engineer to learn the conditions in all parts of the district each day by telephoning the Boston office from the yard in which he happened to be working.

13. A second message was sent to all foremen at the end of the first week of the epidemic to the following effect: "Do not relax your watchfulness for influenza. In all yards those crews in which men are sent to the hospital upon first symptoms have few cases. In crews where sick men are allowed to work, nearly all get the grippe. It is up to you to keep the yard from being tied up. We rely on you." In many yards also the foremen were called together by some member of the medical staff and given further instruction.

14. Later, follow-up posters warning against the dangers of sequelae were posted in all yards. These posters were printed on white cardboard 22×28 inches and the following copy was used:

WHAT FOLLOWS INFLUENZA?

You are in Danger Until Completely Cured.

While your cough continues, even though you feel well, there is danger from a RELAPSE, PNEUMONIA, COLDS, and TUBERCULOSIS.

TREAT YOUR COUGH UNTIL CURED.

GET A DOCTOR'S ADVICE FOR *any ill effects of influenza.*

DON'T RELY ON YOURSELF.

After work when wet and exposed
Get a dry rub with a rough towel.
Put on dry clothes and footwear.

Don't let others cough or sneeze in your face.
Avoid getting chilled. Dress warmly.
Get plenty of sleep. Eat clean wholesome food.

Your body is the most important machine you have to take care of. Don't neglect it.

Dept. of Health and Sanitation. Emergency Fleet Corporation.

It is always difficult to measure the benefits of a campaign of disease prevention. Certainly the writer desires to claim no wonderful and unusual result from the program carried out. It is believed that the above-mentioned activities are those, in the main, which any industrial hygienist would have undertaken, and the results so far as they can be determined are, therefore, interesting in placing an estimate upon the

value of industrial hygiene for this type of industry.

A continuous and intimate association with the activities of each plant during the period in question was more convincing than concrete data, which were later available, in demonstrating the value of the campaign. Our health organization was too busy to get the statistics during this epidemic, and it was particularly difficult to check up data in the shipbuilding industry because in many yards the labor turnover and the number of men absent from work under ordinary conditions were both great. Nevertheless, some facts concerning the experience in these plants are available.

No shipyard escaped without at least a few cases. On the other hand, it does not appear that many men became infected in working hours. A study of employment records shows only one instance in which a large number of men from the same working group went on the sick list at approximately the same time. The foremen generally accepted the responsibility placed on them and erred in the right direction by sending too many rather than too few suspects to the doctor for examination. The single instance just cited was in a small wood shipyard which was under the supervision of a thoroughly competent physician, and the infection occurred during a necessary two days' absence of this official. The man in the air-compressor room was in the initial stages of a severe case of influenza and nearly all the men who had occasion to go into this room during the day later developed the disease.

In some yards, as in the four wood shipyards at Portland, for example, the absentee records were not affected by the epidemic. Although there were a few cases in each yard, they were not numerous enough to increase the percentage of absentees to a point where this increase could be detected. In the yard at Groton, Connecticut, there were about 2100 men over 400 of whom were housed at barracks and in cottages on the company property at a place called the Farm. The following brief report was sent to me on October 5, from the physician's office, having been prepared by the non-medical aid:

"1. Total number of cases to October 5, 1918, 59.

2. Total company expenses, $50.55.

3. Thirty cases sent home out of 200 cases examined by Dr. Purdy.

4. Twenty cases treated at Farm Hospital Barracks at Company's expense.

5. Nine cases in Farm cottages.

6. No deaths.

The situation seems to be under control."

It should be stated that the fifty-nine cases referred to under item 1 are the cases treated by the plant physician and that the expense of $50.00 does not include the salary of the nurse which was also paid by the company.

At other yards the physicians adopted the policy of sending home all suspicious cases, telling the men to report at the hospital next morning if they felt fit for work and in any case to report back to the hospital before re-entering the yard. This is probably the proper system in a disease so difficult to diagnose as influenza and so infectious in the early stages. In 75 per cent. of the yards there was a noticeable increase in the number of absentees during the influenza period and in the three yards most affected the number of men absent because of influenza reached 10 per cent. of the working force.

It is believed also that the successful isolation of several food handlers at a time when premonitory symptoms first appeared prevented the infection of a large number of men. The energy and the thoroughness with which the physicians at the various plants performed this important task deserves high commendation. There were a few cases where food handlers were sent home and did not subsequently develop the disease, but I found no restaurant where a food handler who had the disease was still working.

In only eleven yards were the records of death so carefully kept that I considered them reliable. These contained a total of 24,350 men and from this group there were eighty-five deaths between September 15 and March 1 which were directly accreditable to influenza. This was a death rate of 3.49 per thousand. In no yard was the death rate higher than 5 per thousand. It may be remembered in this connection that the U. S. Public Health Service Report of August 15, 1919 showed a death rate for the cities of the Weekly Health Index which lie east of the Appalachian Mountains of 5.6 per thousand population for this same period. The same report shows the death rate per thousand persons in certain areas surveyed in Maryland, San Antonio, San Francisco, New London, Louisville, Little

Rock, Spartansburg and Quantico to have been a little less than 5 per thousand.

It was impossible to secure reliable morbidity statistics but it is believed that the relatively low death rate was due to suitable care in addition to a low case rate. It was possible to get case histories concerning a few of the fatalities. One of these was that of a man who was working by himself in a lumber yard and did not go to see the doctor until he was critically ill. In each of several other cases the patient had attempted to go out before his strength had returned and had suffered a fatal relapse.

It seems, therefore, that to impress upon the men the seriousness of the disease and the need of prompt, continued and suitable treatment, at the same time letting them see that they are safer from infection when at work than when anywhere else, saves lives and promotes efficiency.

HOME WORK *

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HOME work † is practically the No Man's Land of the industrial world. The public, acting through legislative committees, investigators, and social workers, has for at least three-quarters of a century been looking periodically into this land and has recommended its elimination over and over again.

Even when this country had not as yet swung fully into the industrial period, Matthew Carey made studies which attracted much attention to home work in Philadelphia in 1829–1830. In 1840 Thomas Hood stirred the hearts of his countrymen with his *Song of the Shirt*, and in the ten years that followed Charles Kingsley again roused them with his *Cheap Clothes and Nasty* and *Alton Locke*, describing the conditions of life and labor of Britain's home workers. From 1888 to 1890, the British House of Commons was engaged in a study of sweated industries, the results of which were published in a five-volume folio report. This report paid special attention to the subject of home work.

In 1892, the United States House of Representatives ordered an investigation of the sweating system by a special committee of the Committee on Manufactures. The British Royal Commission on Labor again dealt with the subject in 1892–1894 and later. Canada studied it in 1900; Vienna, in 1902. France, Belgium, Italy, and Germany have all reported upon it in the last ten years.

We still have this problem to deal with, in spite of the constantly recurring objections of health officials, social workers, trade unionists, and others, because employers as a whole are not interested in abolishing it. Even as recently as in the past year, such a responsible body of presumably intelligent men as the toy manufacturers of America, in their meeting at Atlantic City, went on record as advocating its increase in their industry — ostensibly to give work to partially disabled soldiers.

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† This term is used to cover work done in the home for factories. In England this type of work is called "outwork."

Before patriotism came to the fore as a reason for home work, manufacturers for years said it was to help out the widow with children to support, — in fact, the very words "home work" suggest a means by which a clean, tidy widow may remain at home proudly supporting her children by light work. The grim realities of home work, however, may be seen in the slums of some of our large cities.

Official investigations indicate that it is the married woman who resorts to this type of work to a greater extent than the widow, and that the children do their share of the work with her. Children, far below the legal age for going to work, have been induced to do factory work at home during the past year on patriotic grounds — that they may be "Victory Boys and Girls" and buy War Saving Stamps. That this cheap labor was performed by them for factories at all hours is shown by the yet unpublished results of an investigation of the conditions under which children do factory work in homes, which was made by the Federal Children's Bureau during the present year. But this investigation also shows that it is by no means the patriotic appeal alone that has caused children to do home work.

This study was conducted in Providence, Central Falls, and Pawtucket, R. I. It was found that in the homes of about 2900 children visited more than 150 kinds of work were done for many factories. Various kinds of jewelry, both cheap and expensive, are assembled in homes. Small articles of jewelry, dress snaps, military buttons, shoe buttons, and other buttons are carded; lace is clipped, "strung," and scalloped; chenille dots are pasted or stitched on veils; rosary beads are strung, and rosaries are looped and tied in boxes; clasps are sewed on ribbons for wrist watches; screws are put in earrings; peanuts are shelled; toilet paper is packed; toys are painted, and parts of toy horns are assembled; jackknives, hot water bags, dog chains, and parts of shank buttons are assembled; picture frames are made; ten-cent-store celluloid jewelry and other novelties are painted.

The results of the study are not yet available but the extent to which the children claimed to have worked long hours, and during periods when influenza or other diseases prevailed in the home, and how home work affected their home life, will be brought out in this report.

At the time the detailed study of children engaged in factory work at home was being made by the Children's Bureau of the Department of Labor, the Woman's Bureau of the same department undertook a brief inquiry into the conditions of homes in Connecticut where factory work was done. They found exceedingly low rates of pay and low output in the unsupervised home processes, and general inefficiency in the entire home system, which required workers to call for and deliver goods to the factory at irregular times. Metal foot presses were found in some of the homes. These were used to clamp hooks on garters.

Employers have contended that the home-work system is an advantage to them in that it lends itself to the most minute subdivision of labor so that unskilled workers may be used; organization is more difficult among workers not gathered together in the shop; people who cannot go far from their homes and otherwise would not be employed at all can afford to work cheaper; children in the family can assist they escape the restriction of hours which some states impose upon the work of women and children; it saves space and rent, consequently heat and light, and the cost of shop supervision; and it is an escape from troublesome factory laws in general.

Some of the economic advantages to the manufacturer are obviously disadvantages to the worker. Among other disadvantages to the worker who, of course, always works on a piece-price basis, is the fact that he or she usually is not given processes upon which skill, having an economic value, can be acquired.

Definite opinions on home work given by employers are quoted in the last comprehensive government report of this subject (*Women and Child Wage Earners, Men's Clothing*, published by the Department of Labor, Washington, 1911) as follows:

"If home finishing were done away with by law the clothing industry would not be seriously affected. It would mean an advance toward better and more sanitary clothing."

"A national law prohibiting home finishing would cause trouble in the beginning but would do much good in the end."

"I see no disadvantage to worker or employer in having pants finished at home, although it is awful on the pants sometimes. . . . Once in a great while garments have been mice eaten, and then the finisher has had to pay for them. . . . If public opinion is against tenement-made goods, it cuts no figure whatever."

"I wish that there was a law to prohibit home finishing. While it is cheaper to have garments finished at home, I would rather have it done in my own shop, and if there were a law which all had to obey prohibiting this, the price of garments would rise to cover this increase and the contractor would not suffer. I could not afford to abolish home finishing in my own shop. . . . The women do more at home — they work longer hours. No matter how quickly I want a lot of pants they get them to me, and I know they work unlimited hours."

"Most of the finishing on pants is done in homes. Finishers cannot earn enough money in the shops to pay them to come and stay all day, but the Italian woman who has a lot of children to care for and her husband's meals to cook has a chance to make a little money in between times and her time isn't worth anything to her, so it's a good thing for her."

Low standards of living are imposed in making a home into a workshop, littered up with ravelings, scraps, and articles worked upon. A mass of garments or other factory goods strewn about the kitchen and living rooms is not conducive to the creation of a suitable home atmosphere for the rearing of children. When mothers have a batch of work to complete for the factory, the household cleaning and cooking is likely to be slighted. Young children, presumably protected by factory laws from shop work even with sanitary conditions, are pressed into the service of the factory or have heavy home duties imposed upon them when factory work is brought into the home.

Great irregularity exists in home work. Sometimes this is voluntary. Families will slacken up in the home work when the husband's earnings are adequate. The husband, on the other hand, at times has not the incentive to work steadily when he knows that the women of his family and even the children below legal working age can secure home work.

But ordinarily the irregularity is involuntary, and is an inherent characteristic of the home-work system. Women who do factory work at home, it has been found, generally cannot set apart any specified number of hours to depend upon as their work-day. They must work long hours

when the work is in a rush, and then defer or neglect the obligations to their homes and children. But, on the other hand, when work is not rushed they can generally take it up in leisure moments. In some cases, freedom to work when they please on the factory product resolves itself into a sort of moral compulsion to work far into the night when work is available. Theoretically some women stay in the home to do factory work so that their households may not be neglected, but, as a matter of fact, the households are neglected. While many married women turn their homes into workshops because they are unable to leave their families and work in the shop, many other persons, investigation has shown, could and do go into the shop when home work is not available.

Federal investigations have shown that the majority of home workers are found in the group where the wages of the father or husband, the natural wage earner, are insufficient. A statement by John R. Commons, in the *Industrial Commission Report* (Vol. 15, 1901), no doubt is still true, that is, that the Italian laborer is able to bid at much cheaper rates for employment in his occupation because his wife and children do factory work in the home at about two-thirds the price which other nationalities formerly received.

It has generally been found that rates for home work are lower than for shop work. Handicapped persons and children, so often found working at home, underbid the regular factory worker. The manufacturer not only saves in this way, but economizes in floor space, in rent, heat, light, and equipment. To force employers to have all their work done in the workshop would be to shift from the shoulders of the home worker the burden of expense of rent, heat, and light to the shoulders of the employer.

The Commissioner of Labor for New York, referring to home work in his report of 1917, says:

> "In general, the inducement to resort to it (home work) is the extremely low rate at which women can work in their homes intermittently, along with household duties, in order to supplement family incomes. But this low rate yields only starvation wages to those who have to depend upon it alone for their livelihood. It is what has been called throwing workers into starvation and then using their starvation as a measure of all other workers' wages."

Reports on the subject of home work, covering a range of more than fifty years, invariably stress the fact that factory goods not made in factories are generally made in dirty homes. This is true of British, French, Italian, Belgian, German, Canadian reports and those of our own federal government and the various states. All of these reports contain vivid descriptions of the filth amidst which the home work is done.

Sir Thomas Oliver, in his work on *Dangerous Trades*, page 98, says:

> "Apart from the points of starvation wages and excessive hours, one of the main facts brought out by recent investigations into home work is the grave danger to the health of both the worker and the community at large, arising from the making of garments, etc., in disease-infected and otherwise insanitary houses."

No case is on record where contagion has actually been proven to have resulted from tenement-house manufacture, but cases are common where it is impossible to trace the cause of the influenza or other disease of a patient. In the forties, however, before the launching of the germ theory of disease, Charles Kingsley declared that the daughter of a nobleman had become infected with smallpox because her riding habit had been made up in a home where there was smallpox. It will probably always be impossible actually to prove in special cases the risks of injury or of danger to the health of the public from articles handled in homes where disease, dirt, and vermin are found.

During a smallpox epidemic in Chicago, inspectors found on the thirtieth day of the month, in a home where a child had died of smallpox on the twenty-eighth, sixteen coats in the process of manufacture; and the mother admitted that they had all been in the home during the period of the child's illness. The records of the firm owning the clothing showed that sixty-one coats had been returned to the firm while smallpox was in the house. The firm agreed to have the coats disinfected nine days later, after they had been returned to it.

The attitude of another manufacturer was somewhat different from that of the firm just referred to. This manufacturer, when a garment belonging to him was found in a home where the child was suffering from smallpox, said he preferred to have the coat destroyed rather than fumigated and returned to the shop. A health inspector demanded the coat of the contractor who refused to give it up without

pay, and as the inspector had no authority to pay for it the destination of the coat was unknown.

The federal government report on clothing, before referred to, goes into the question of the danger of contagion to the consumer. It states that garments are often made, or at least finished, in dirty homes, and that the investigators found that physicians who would agree to conceal from the health department cases of contagious diseases were most popular with garment workers; that the workers themselves testified that a "nice" doctor wouldn't tell on poor women when contagious diseases were in the house because if he did the police wouldn't let them work on the garments. In some of the poorer families where home work is done, physicians are not generally called for such diseases as measles, mumps, and whooping cough, as the mothers try to treat them themselves so that the home work will not be interrupted because of the quarantine sign.

This report cites the case of a mother of a child with whooping cough who thrust her fingers down the boy's throat as a means of relieving him when he had a coughing spell. She then wiped her fingers, covered with mucus, on the pants on which she was at work.

Another mother of a child whose head and face were covered with a loathsome rash, which she stated her doctor had told her was a "ketcha disease," passed her hands caressingly over the rash on the child while working on the garments.

In one case a sick youth, lying on a quilt near his mother while she worked and placed the garments beside him, was said by the family to be suffering from a sexual disease.

In another case, a physician testified that he found a girl "dressing open sores on her left hip and thigh, right knee, and left great toe, with sliced tomatoes and old strips of bandage that had been used repeatedly and washed out by her mother with the family wash, or by herself." The girl told the physician that a diagnosis of bone tuberculosis had been made at the Hospital for the Ruptured and Cripples of New York City. The investigator saw this girl pull the gauze out of the diseased sinus and lay it beside her on top of the garments upon which she had temporarily suspended work for the purpose of dressing her sores.

Current laws recognize the danger to the consumer when garments or other articles are handled in the process of manufacture by persons suffering from disease. In Massachusetts and New York and certain other states, factory inspectors are required to tag garments as tenement-made when they are made under conditions which it is believed make them carriers of disease. In some states, when goods are disinfected, the label may be removed; in other states, goods subjected to contagion are destroyed.

One employer has stated: "If a garment is made in a tenement which is dirty or where there is an infectious disease, it does not hurt the wearer. Pressing with a hot iron will kill any germ. Once in a while we have had garments made in unlicensed homes. The factory inspectors labelled them, 'Made under insanitary conditions,' but we always tore the label off."

But whether or not the public health is endangered by this type of manufacture cannot be asserted here. The fact remains, however, that legislation on the subject of home work in the several states in this country and throughout Europe has not been on behalf of the workers but on behalf of the consumer and has been based upon the assumption that this form of manufacture constitutes a menace, or at least a risk, to the consumer.

It is for the physicians to tell us whether or not the consumer's health is jeopardized when peanuts can be shelled, rosary beads made and linked, chenille dots put on veils, children's toys painted and assembled, and all kinds of garments made or finished in families where contagious and infectious diseases rage.

John R. Commons states in the *Industrial Commission Report* (Vol. 15, p. 382, 1901) that, owing to revelations regarding the contagion of measles and similar diseases in army camps during the Spanish-American War, the government specified that sweat-shop work would not be accepted. The War Office of England, in the interests of the health of the soldiers, has for years specified that no work on military clothing shall be done in the homes of work-people.

Neither the federal nor any state government has a definite prohibition of home work. Instead of that, some states resort to very expensive schemes of licensing and inspecting. Generally, states attempt to regulate sanitary conditions of tenement

manufacture by providing that manufacturers shall not give out work to be done in any unlicensed home.

The Commission of Labor of New York has stated that it is impossible to carry out the provision of law which requires that every tenement-home license for factory work shall be thoroughly inspected twice annually, because the department staff is hopelessly inadequate.

Year after year state factory inspectors report that inspection of home work is a failure, as it is expensive and inefficient because no state has funds enough to insure satisfactory inspections. Anyone who has ever visited the homes where factory work is done will testify that if the standards of cleanliness of the inspectors were very high few licenses would be issued, and few licenses would continue. State and federal reports have shown that home work can be and commonly is being done by persons who, according to physicians' diagnoses, are suffering from tuberculosis, syphilis, and other diseases, and, during the past year, from influenza. It would seem that the most efficient plan would be to require that all manufacturing be done in factories and workshops, where it is possible to standardize conditions of sanitation in the interests of the health of the workers, and also of the consumer.

The sanitary value of the concentration of garment workers in factories, the sanitation of which can be regulated, is unquestioned from the standpoint of the health of the worker and the health of the consumer. This consideration alone would seem to justify laws for the complete elimination of tenement manufacturing and home work on factory goods in general.

THE SANITATION OF INDUSTRIAL WATER SUPPLIES *

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DURING the years just past, necessity has forced upon our attention two very opposite fields of invention and inquiry, one relating to the destruction of man, the other to his conservation. With the coming of peace it is hoped that the latter will secure the same energetic support which both received during the war. Of the many branches relating to the conservation of human health and life, only few are of greater moment than that of industrial hygiene and sanitation. Vitally important as a factor in the successful termination of the war, it remains today a fundamental consideration in the solution of the problems of social and industrial reconstruction. The study of industrial hygiene and sanitation covers a very wide field of investigation calling for the coöperation of many branches of pure and applied science. One of these, the sanitation of industrial water supplies, has received renewed attention in the light of modern methods and equipment.

The sanitation of industrial water supplies relates chiefly:

(1) to water used for manufacturing purposes;

(2) to water used for hygienic and sanitary purposes;

(3) to water used for fire protection.

While the supply for all three purposes is often derived from one and the same source and while the water is sometimes of great purity, many instances are encountered in which two or even three supplies of varying purity are drawn from or in which different degrees of purification are found necessary for each system.

Water Used for Manufacturing Purposes

The sanitation of water employed exclusively for industrial purposes depends largely upon the uses to which it is put. The standards of purity are often above those ordinarily required for drinking water supplies, especially those relating to the chemical and physical condition of the water. Distilled waters are often encountered in the industries, most frequently perhaps in establishments engaged in the preparation of food stuffs or allied substances in which the water becomes an integral part of the product or otherwise comes into contact with the same during manufacture. In such industries as brewing, distilling, and sugar and starch making, the microbiological condition of the water is most important, as the presence of certain micro-organisms in the water may produce abnormal fermentations that injure the product.

The requirements of certain other industries are not quite as stringent. In those textile plants, however, in which water is used for humidifying purposes, it is quite evident that the supply, even if not of drinking quality, must be sufficiently pure so as not to give rise to disagreeable odors or act as a means for the transmission of disease. In other cases again, only the physical and chemical condition of the water are of importance. The chemistry of boiler-feed waters is of common interest to nearly all manufactories, while iron-bearing waters are especially undesirable in dye-works and paper and pulp mills. The preparation of water for use as process water in these specialized industries, however, involves studies of little interest to the sanitarian.

A large number of plants, finally, use water only as a form of energy to move water-wheels, to condense vapors, to cool liquids, etc. In practically all such cases neither the sanitation nor the chemistry of the supply needs consideration. When, however, impure water is introduced into factories, it should be so distributed that there is no chance of its contaminating pure water supplies and so protected that it cannot be used for drinking purposes. Where it is impossible to secure the last mentioned result, the water may be disinfected in such a manner as to render it safe or, otherwise, unfit for drinking purposes from the standpoint of the worker.

Water for Hygienic and Sanitary Purposes: Drinking Water

The sanitation of the water supplied for drinking purposes is of common importance to all industrial establishments on account of the close relation between health

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or comfort and drinking water, and the dependence of working efficiency upon the health and comfort of the worker. This fact has been fully recognized by progressive plants, and excellent drinking-water systems are of common occurrence. Nevertheless, there remain many establishments which have installed drinking-water facilities without consideration of plant conditions. It should be conceded that the planning of the system is strictly an engineering problem which, if effectively studied and logically executed with relation to source, quality, and distribution, will give better results with a lower expenditure than the usual haphazard way of meeting demands as the occasion arises.

Sanitary Legislation

Industrial plants are usually required by law to provide pure drinking water for their employees. The sanitary legislation relating to drinking water in industrial establishments in Massachusetts, for example, provides that fresh and pure drinking water, to which their employees shall have access during working hours, must be provided by all industrial establishments within the commonwealth (1). Similar laws are enforced in New York and other states of the Union (2).

The British Health of Munition Workers Committee (3) makes the following statement: "An order has recently been made by the Home Office under the Police, Factories, etc. (Miscellaneous Provisions) Act, 1916, section 7, under which, in all factories and workshops in which 25 or more persons are employed, provision shall be made at suitable points, conveniently accessible at all times to all persons employed, for—

"(a) An adequate supply of wholesome drinking water from a public main or from some other source of supply approved in writing by the local authority of the district in which the factory or workshop is situated, which shall be either laid on or contained in a suitable vessel;

"(b) Except where water is delivered in an upward jet form which workers can conveniently drink) at least one suitable cup or drinking vessel at each point of supply with facilities for rinsing it in drinking water.

"Each drinking water supply shall be clearly marked 'Drinking Water.' All practicable steps shall be taken to preserve water and vessels from contamination."

Source of Water

In many cases, industrial concerns situated in or near towns or cities are able to obtain connections from the public mains. If the water supply of the community is of established purity, it is often advisable to obtain drinking water in this way. If this is not the case, it may be necessary to provide an independent supply or to modify that of the city or town. Large industrial establishments and isolated plants often find it to their advantage to make use of a private source. A recent study of welfare work for employees in the industries by the United States Bureau of Labor Statistics (4) showed that of the establishments reporting the source of their supply of drinking water eighty used water from city mains, while fifty used well water. It was also ascertained that seventy-nine establishments filtered the water or otherwise purified it.

Whenever it is necessary or economical to seek an independent supply, it is possible to obtain the same from the following different sources:

1. Surface waters:—streams, lakes, reservoirs.
2. Shallow wells.
3. Deep or artesian wells.

The nature of the supply depends to a great extent upon the location of the plant. As indicated above, deep wells are the usual source of supply of drinking water. In densely populated districts, water is more readily obtained pure from this source than from surface supplies or shallow wells which are more exposed to pollution or contamination from neighboring habitations.

If, however, it is imperative to use water from streams, lakes or reservoirs, the supply should be thoroughly purified, unless it is obtained from uninhabited catchment areas or is otherwise safeguarded.

If wells are used, particular attention should be paid to their construction and location. They should be so situated with respect to possible sources of pollution that there is no danger of their becoming infected. Shallow wells should be lined with water-tight walls which are carried above the surface of the ground. They should be tightly covered and provisions should be made to carry surface water away

from the well. Deep wells should be protected against pollution entering along the exterior surface of the well-casing and should be carried to a sufficient depth to insure a supply of uncontaminated ground water. Wells in limestone country are often dangerous.

Quality

The water delivered to the drinking-water system should be wholesome, attractive, and economical. To be wholesome, it must at all times be free from pathogenic organisms due to contamination or pollution and must not contain poisonous metals or other injurious substances. To be attractive, it must be low in color and turbidity, free from marked odors and tastes, and of proper temperature to insure its palatability. To be economical, it must not contain excessive amounts of those mineral substances or gases which make it corrosive or lead to the formation of deposits in the system or render the water hard. All these conditions may be obtained either by selecting a proper source of supply or by modifying a faulty supply through the use of physical or chemical agents.

It is impossible to lay down hard and fast rules as to the standards of quality. The regulations of the United States Treasury Department for interstate carriers (5) are perhaps the most widely discussed in this connection. Certain state boards of health also are doing excellent work in advising industrial establishments in the choice and maintenance of a satisfactory supply.

Methods of Purification

The methods of purification ordinarily at the disposal of the water-works engineer in the planning of large supplies for municipalities are not easily adapted to the limited use under more or less unfavorable conditions which may be required of them in congested industrial establishments. The agencies of purification employed must, therefore, depend upon local conditions and their relation to:

(1) the quality of the water supply;

(2) the economy of modifying the same by different methods;

(3) the location of the plant and the amount of space available;

(4) the method of distributing the supply;

(5) the supervision which it is possible to obtain.

Aëration

The aëration of water is not frequently seen in industrial purification plants, although its wider use might well be advocated. It is an efficient means of introducing air into water deficient in dissolved oxygen and at the same time of removing objectionable gases such as carbonic acid, hydrogen sulphide, and others which make the water corrosive or otherwise objectionable. This modification of the gaseous content of the water also results in the precipitation of iron or manganese which may have been in solution. The precipitates, often flocculent in nature, may be removed by subsequent filtration. The process is, furthermore, effective in removing odors and tastes produced by the growth or decay of certain micro-organisms. Aëration is accomplished by bringing small drops of water into intimate contact with air, sometimes by allowing water to drop through the air, and sometimes by spraying it into the air in small jets. The devices applicable to the process are simple in construction and easily adapted to meet individual conditions.

Sedimentation and Coagulation

Considerable amounts of mineral and organic matter which are held in suspension by rapidly moving water may be removed by decreasing the velocity of the water in settling basins. This process of settling suspended solids may be hastened by the addition of chemicals which form a bulky gelatinous precipitate tending to coagulate small particles, ordinarily held in suspension, into masses of larger volume which are more readily removed by sedimentation or filtration. Unless sedimentation is applied merely as a preliminary process to filtration, the time of subsidence required to remove a sufficient amount of suspended matter is usually so great that the required capacity of the basins makes this process uneconomical for manufactories. More often sedimentation and coagulation combined are used in preparation for mechanical filtration. Under these circumstances, it is often possible to shorten the period of subsidence materially, although it is not desirable to decrease it very much. The capacity of the settling tanks, however, is often limited by economical considerations, by the lack of space

in congested establishments, and by the use of pressure systems in place of gravity supplies. Under these circumstances, the period of retention in coagulating basins is often decreased to the time required for the formation of a good "floc," the burden of removing all suspended matter devolving upon the filters. The coagulants in general use are alum in the form of sulphate of alumina or crystal alum, and ferrous sulphate together with caustic lime. Besides effecting a removal in suspended matter, these chemicals are of special assistance in freeing water from color.

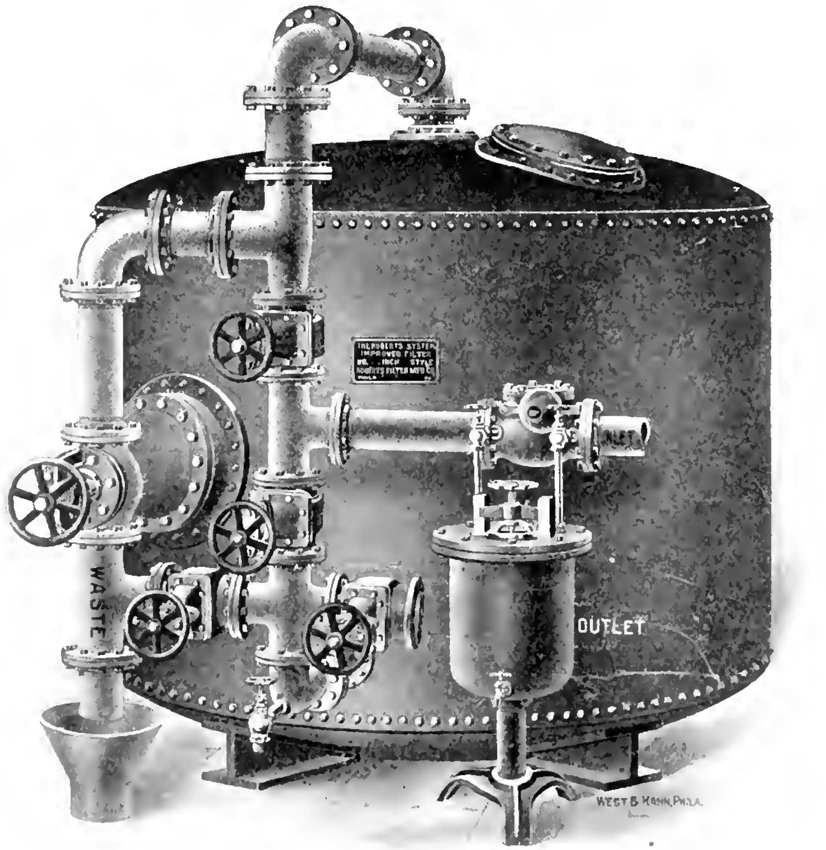

Fig. 1. — Vertical pressure filter. (*By courtesy of the Roberts Filter Manufacturing Co.*)

Filtration

Sedimentation or coagulation is not needed in relatively clear and colorless waters. Bacteria and other particles in suspension and, in general, about 25 per cent. of the color may be removed by filtering the water through sand or some other fine material at a low rate. This process, known as slow sand filtration, is seldom used for industrial supplies, as the filtering area is usually too large. Also the method of cleaning the sand-bed by scraping off the surface layer and washing the sand removed is not well adapted to industrial conditions. The more common method of filtration used is one known as mechanical or rapid sand filtration in which the water is passed through a layer of sand at a relatively high rate, about twenty-five times as great as that used in slow sand filtration, the sand being washed by reversing the current of water or by other means when it becomes dirty. The water is usually applied to the filters after preliminary coagulation.

A great many types of mechanical filters may be seen in industrial establishments, some operating under pressure, others by gravity, as illustrated in Figures 1, 2, and 3. The coagulant is often added to the water immediately before the filter and without permitting sufficient time for the reaction to become most effective. Even by this procedure fairly good results are obtained which, however, still permit of improvement. The removal of bacteria by mechanical filters is doubtful and should be supplemented by disinfection.

Disinfection

If water is obtained from a pure source, such as a deep well or an uncontaminated surface supply in which nature has practised its thorough methods of purification, it is not necessary for further safeguards.

Often, however, water is found clear and sparkling in nature or after undergoing some artificial cleansing process without giving assurance of its biological innocence. In such cases the water may be disinfected by the application of some poisoning or other germicidal agent. One of the most widely used of these poisoning compounds is chlorine in the form of sodium hypochlorite, calcium hypochlorite, or, more recently, liquid chlorine. Of these, liquid chlorine is perhaps most readily adapted to industrial needs as it is easily applicable to all types of systems, is automatic in action, if necessary, and requires little space. Chlorine is best applied after filtration, although a saving in chemicals is sometimes effected by introducing the chlorine before the coagulant is added. To prevent aftergrowths of bacteria, it should be applied as near the inlet to the distributing system as possible. Figure 4 illustrates an automatically controlled chlorinator in which the dosage of disinfectant for each unit volume of water is kept constant independently of the rate of flow.

Other chemical disinfectants less frequently used are ozone and copper sulphate.

The use of photochemical energy in the form of ultraviolet light constitutes a new departure in the disinfection of water. In this process the rays of short wave length (.18 to .35 microns) emitted by a quartz mercury vapor electric lamp are utilized to kill bacteria and other living organisms commonly found in water. The apparatus necessary to accomplish the thorough disinfection of water by this means is well adapted to industrial conditions. The process may be automatically controlled, is applicable to all types of distributing systems, and does not impart undesirable odors or tastes to the water, a condition often met with in other methods of disinfection. Aftergrowths of bacteria may be avoided by placing the equipment in the recirculating line. This is hardly possible with any other process of disinfection. Three different types of apparatus are illustrated in Figures 5, 6, and 7.

Refrigeration

It is often necessary to cool water used in drinking-water systems. If ice is used for this purpose, it may be placed in the water or may be allowed to jacket a coil through which the water flows. The first method is unsafe, as the water may become contaminated when the ice is impure or has been handled under unsanitary conditions. Also if the drinking fountains supplied in either one of these ways are operated intermittently, the reduction in temperature is too variable, the first water drawn being ice cold, the remainder warm. Wherever the size of the drinking-water system warrants it, mechanical refrigeration should be resorted to. This method is especially applicable to systems known as recirculating systems, in which dead ends are avoided and the water circulates constantly through pipes insulated against heat absorption by covering them with materials of low heat conductivity. An outline of a cooling system is given in Figure 8.

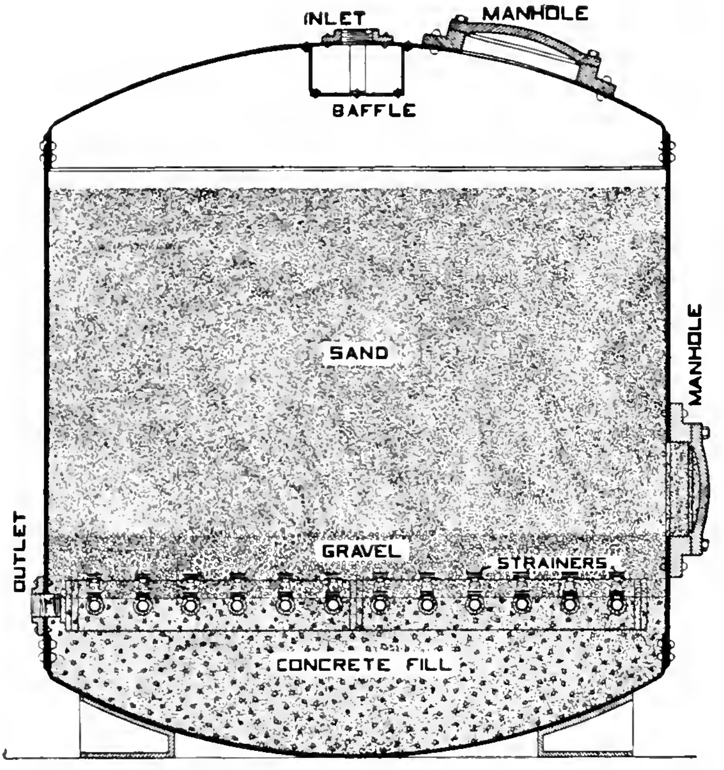

Fig. 2. — Section through vertical pressure filter. *(By courtesy of the Roberts Filter Manufacturing Co.)*

Quantity

It is important that employees be encouraged to drink sufficient amounts of

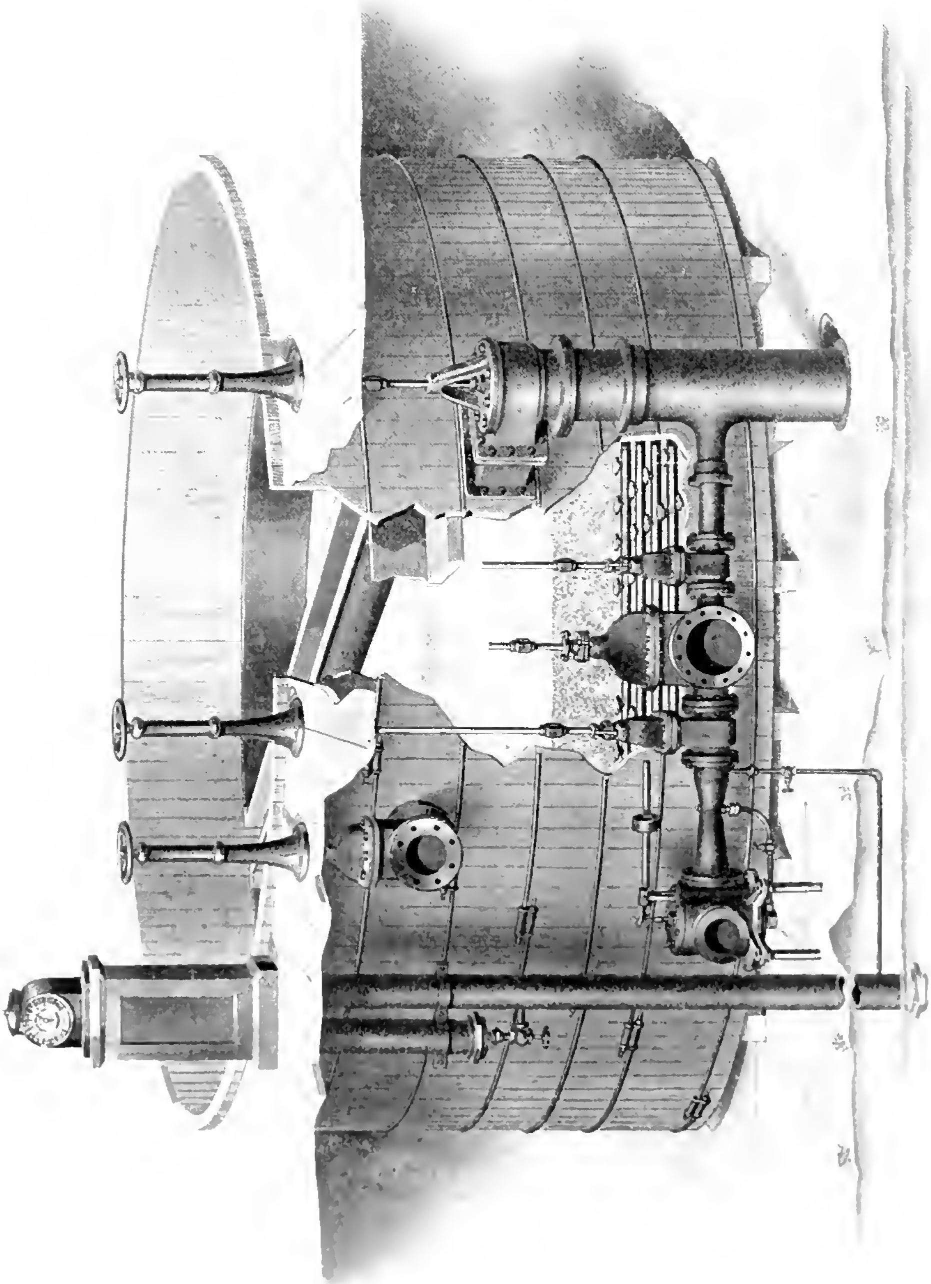

Fig. 3. — Gravity filter. (*By courtesy of the Roberts Filter Manufacturing Co.*)

water to meet the physiological needs of men at work. In this connection the following extract from a report of the United States Public Health Service is of interest (6).

"Since so much body water is lost under conditions which provoke free perspiration, it is important that an ample amount of water be drunk to replenish the tissues thus deprived of their normal water content. Without this, their proper functions will be hampered and health and efficiency cannot be expected. The worker should be furnished with an abundant supply of water, together with drinking facilities which are clean, attractive and placed so as to be conveniently accessible at all times. The water should never be below 55° F. in temperature, as the drinking of cold water is likely to cause gastro-intestinal disorders. . . . Though under ordinary conditions the amount of heat lost in bringing the temperature of water up to that of the body is small, this amount, by judicious drinking, can be increased. Water should be drunk in small quantities and at frequent intervals, not in large quantities at infrequent intervals."

On the average, a healthy man needs about two quarts of water a day outside of the amount taken as an ingredient of solid food. This amount varies in different industries and in different occupations of the same industry. Men doing hard physical labor naturally require more water than the office force, and men working under high temperatures need more than those working in the cool parts of the factory. More water is consumed during the summer than during the winter and frequently the day shift requires more than the night shift. The palatability and appearance of the water also influence the amount consumed. Due allowance must be made for waste, the quantity of which varies with the type of drinking facilities, such as continuous and intermittent bubbling fountains. In planning for a drinking-water system only it is safe to take one quart of water per employee per hour as a basis. If the water is to be used for washing purposes also, a larger allowance must be made, the magnitude of which will depend upon the facilities provided.

Method of Distribution

No matter how much care is taken in securing a supply of water which meets all

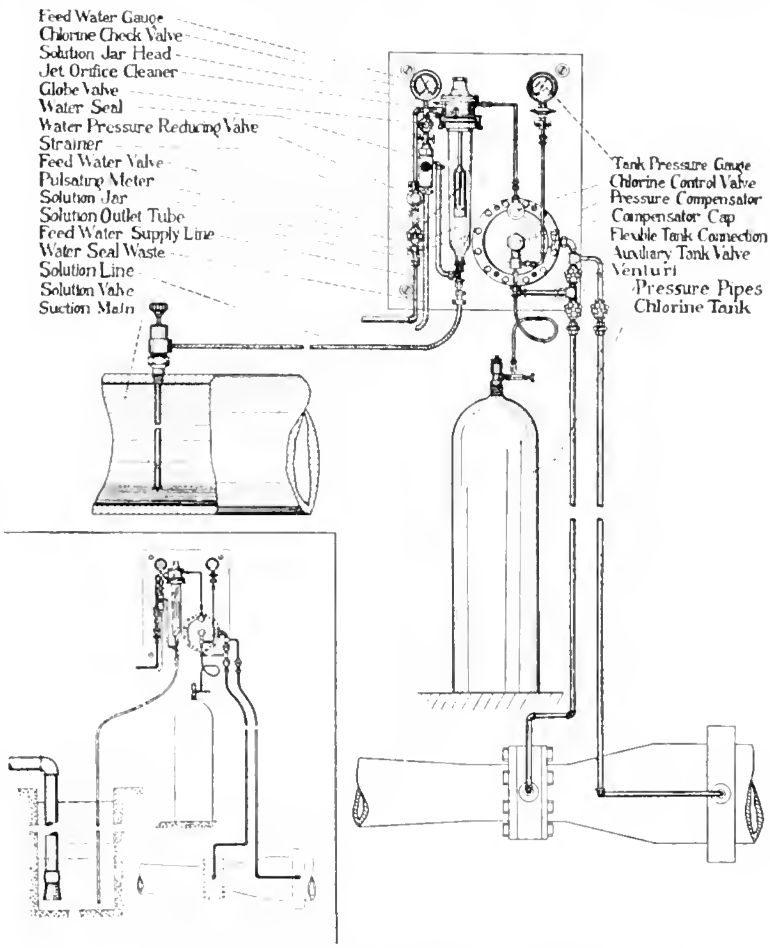

Fig. 4. — Automatic control, solution feed, venturi-operated chlorinator. *(By courtesy of Wallace & Tiernan Co., Inc.)*

sanitary requirements, the work will be sterile of results if the methods of distribution do not permit the consumer to receive the water in its original condition. The real test of purity is the quality of the water actually drunk. In the above-mentioned survey of the United States Bureau of Labor Statistics (4) it was discovered that the disgraceful and wasteful "bucket and dipper" may still be found in a number of places. The use of barrels, tanks, and crocks was also reported, while tin cups hanging alongside faucets were discovered in many factories. Approximately 100

eases, however, reported the use of individual drinking cups, and 236 establishments supplied water to all or to a part of the employees by means of fountains, anything in the nature of a fixture having a nozzle instead of a faucet being so designated. As a rule, it may be said that the American public is aware of the dangers of the common drinking cup and that an earnest effort is being made to insure the use of individual drinking cups or sanitary drinking fountains. This statement does not seem to apply equally well to the British Isles (3).

During the past years the market has been flooded with a great many different designs of so-called sanitary drinking fountains. Unfortunately, however, scientific investigation has proved a large number of these devices undeserving of their name (7). But while it has been shown that some of the types may be a factor in the transmission of communicable diseases, it has also been ascertained that fountains can be so designed that they are safe from a sanitary standpoint and economical to construct. The improved designs make use of an inclined stream to prevent the water from falling back onto the bubbler, which is so housed that the drinker cannot place his mouth on it (4) (7).

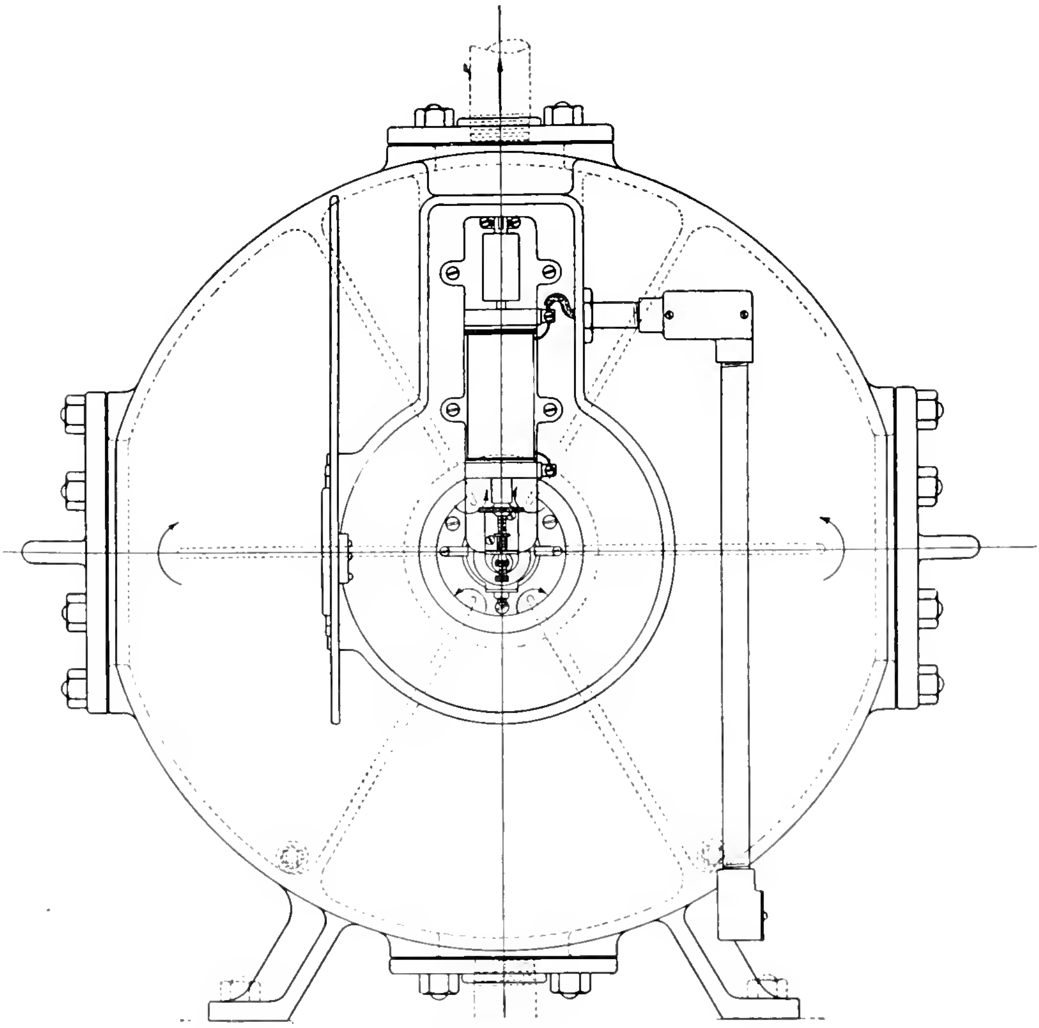

Fig. 5a. — Single lamp, ultra-violet ray sterilizer. (*By courtesy of the R. U. V. Co.*)

Similar results can be obtained with a vertical stream four or five inches high, emitted by a properly designed nozzle. An inexpensive form of drinking fountain is illustrated for sake of discussion. (Fig. 9.) It should be noted that special fixtures are not required in this design.

Drinking fountains should be located carefully with reference to the working

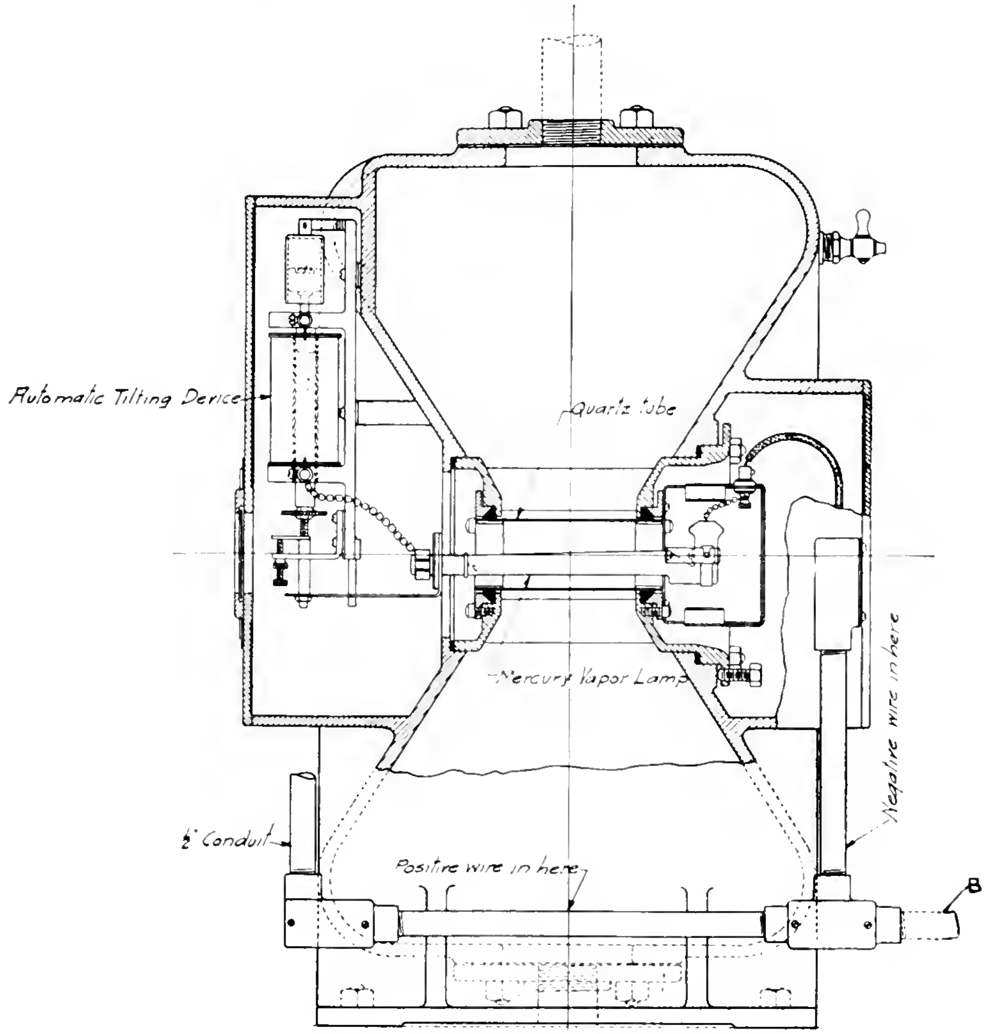

FIG. 5b. — Section through single lamp, ultra-violet ray sterilizer. (*By courtesy of the R. U. V. Co.*)

zone of the employees so that they may be readily accessible and their use may not result in loss of time. The use of spring valves will prevent a large amount of waste.

In industrial establishments which cover an extensive area or in which groups of employees are engaged from time to time in different places, it may be impracticable to install a sufficient number of stationary fountains for all needs. In these cases a good method of distribution is by portable fountains which may consist of small covered barrels or metal containers provided with a spigot and dispensers for individual drinking cups. This method of supply was extensively used by the United States Shipping Board in the emergency shipyards, especially during the influenza epidemic of 1918 (8). It was found that the use of cups is not entirely satisfactory, as the dispensers in which they are con-

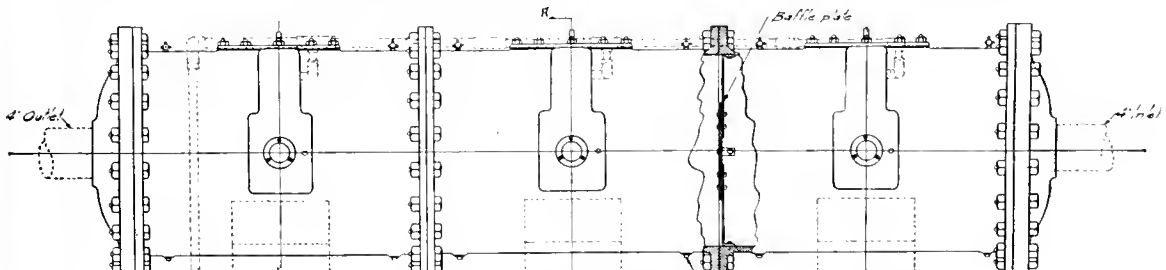

FIG. 6. — Triple lamp, ultra-violet ray sterilizer. (*By courtesy of the R. U. V. Co.*)

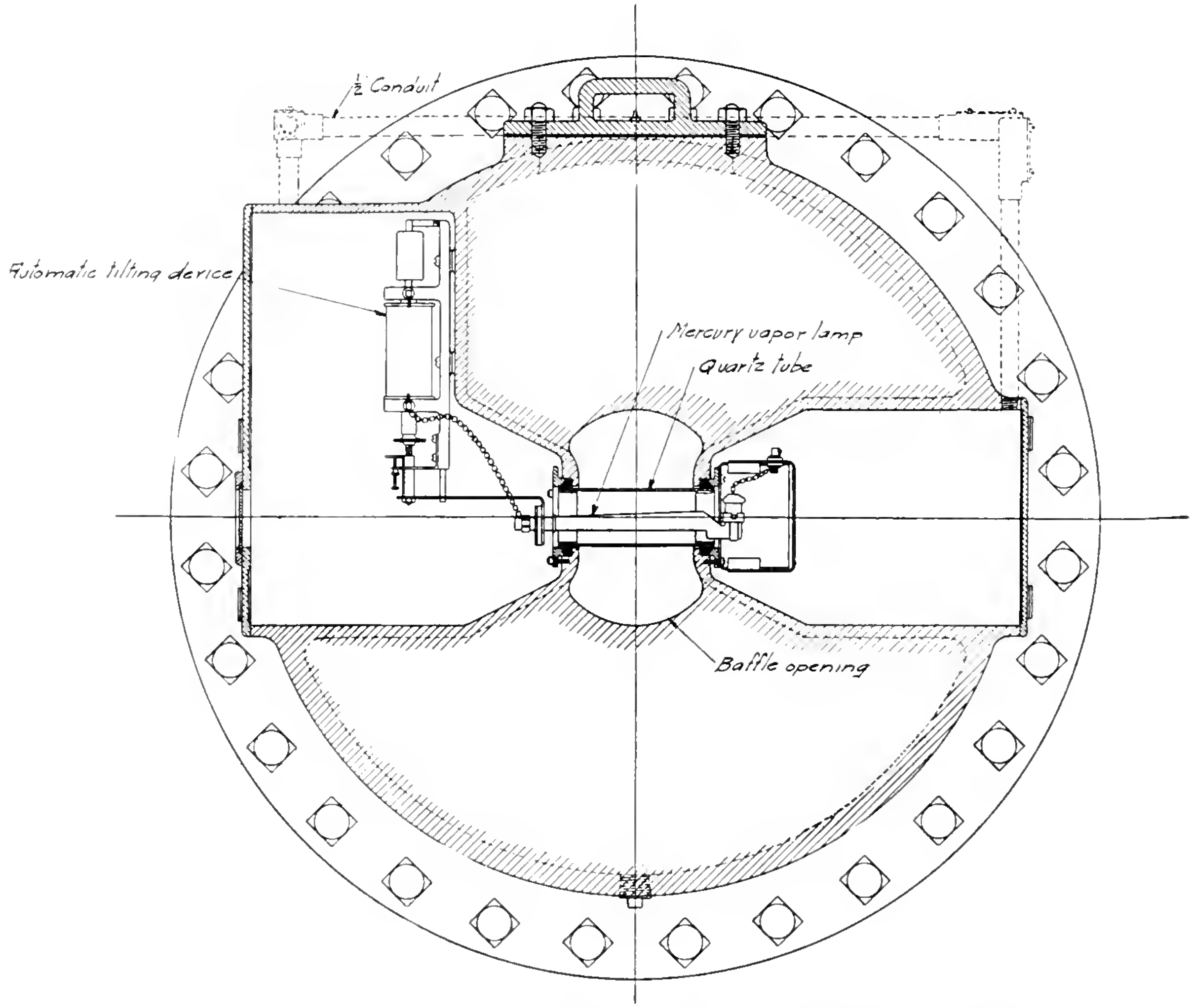

FIG. 7. — Section through multiple lamp, ultra-violet ray sterilizer. (*By courtesy of the R. U. V. Co.*)

tained only carry a limited number of them. The supply is soon exhausted and workmen then pick up cups discarded near the fountains and drink from them.

A larger container having a capacity of 25 to 30 gallons and resting on a stand 3 or 4 feet high may be substituted for the portable fountains. Instead of a faucet it may have a pipe leading to a bubbler fitted with a strong spring valve and surrounded by a bowl connected with a drain pipe. All these types of fountains require careful supervision, since both the reservoirs and buckets need thorough cleaning at regular intervals. In the Alexandria shipyards of the United States Shipping Board an outbreak of dysentery was traced to the circumstance that the water carriers were saving themselves steps by filling the containers with polluted water from the Potomac River (9). Outbreaks of water-borne diseases have also been traced to the interconnection of the drinking-water system with pipe lines carrying polluted water for boiler feed or other manufacturing purposes.

In the thorough sanitation of industrial water supplies, it is not only necessary to provide a safe drinking water; it is also essential to prevent the use of anything but this safe water for drinking purposes. The British provision (3) of merely marking the fixtures delivering drinking water as such is not a sufficient safeguard. Experience has shown that thirsty men will drink any water which is near at hand and that they are especially apt to drink water intended for washing purposes. The washing-water supply should, therefore, be of undoubted purity and is best obtained from the same source as the drinking water. If the drinking water does not require refrigeration, the drinking and washing water systems may be combined in one. If

cooling of the water used for drinking purposes becomes necessary, they must be separated unless the more primitive method of cooling the water in the fountain proper is practised. Wherever refrigeration machinery is used, a closed system is in order in which the water circulates constantly through the pipes, a sufficient amount of fresh water being added to replenish the quantity lost by use. A common form of this type is illustrated (Fig. 8). In this recirculating system the water passes from the cooler through a pump to the distributing lines, whence it returns to the cooler. The distributing lines should consist of several short branches rather than of a single long line. This insures a smaller use of recirculating water for a given rise in temperature and effects greater economy in refrigeration. Drinking fountains should be connected to this system so that the water will flow cold as soon as the valve operating the fixture is opened. A method of doing this is suggested in Figure 9.

The supply line controlled by a suitable float valve in the cooler furnishes water to the system in amounts equal to the quantities drawn. The special apparatus shown along the supply line is only necessary for the modification of unsuitable supplies. Both filters and sterilizers can be made to operate automatically.

Water for Washing and Flushing Purposes

The dangers arising from the use of impure water for drinking purposes have already been pointed out. It is, therefore, common practice to supply all water used for hygienic and sanitary purposes from the same source. Unsuitable supplies may be modified in a similar manner to drinking water. Indeed, water for these purposes is often piped as indicated in Figure 8. Here again, it is essential that the water reach the user in its original purity and to this end particular attention should be paid to the sanitation of washing facilities. In a recent survey of the United States Bureau of Labor Statistics (13), 120 establishments out of 285 reported the use of wash troughs or sinks, while 203 reported the use of individual bowls, a number of places having

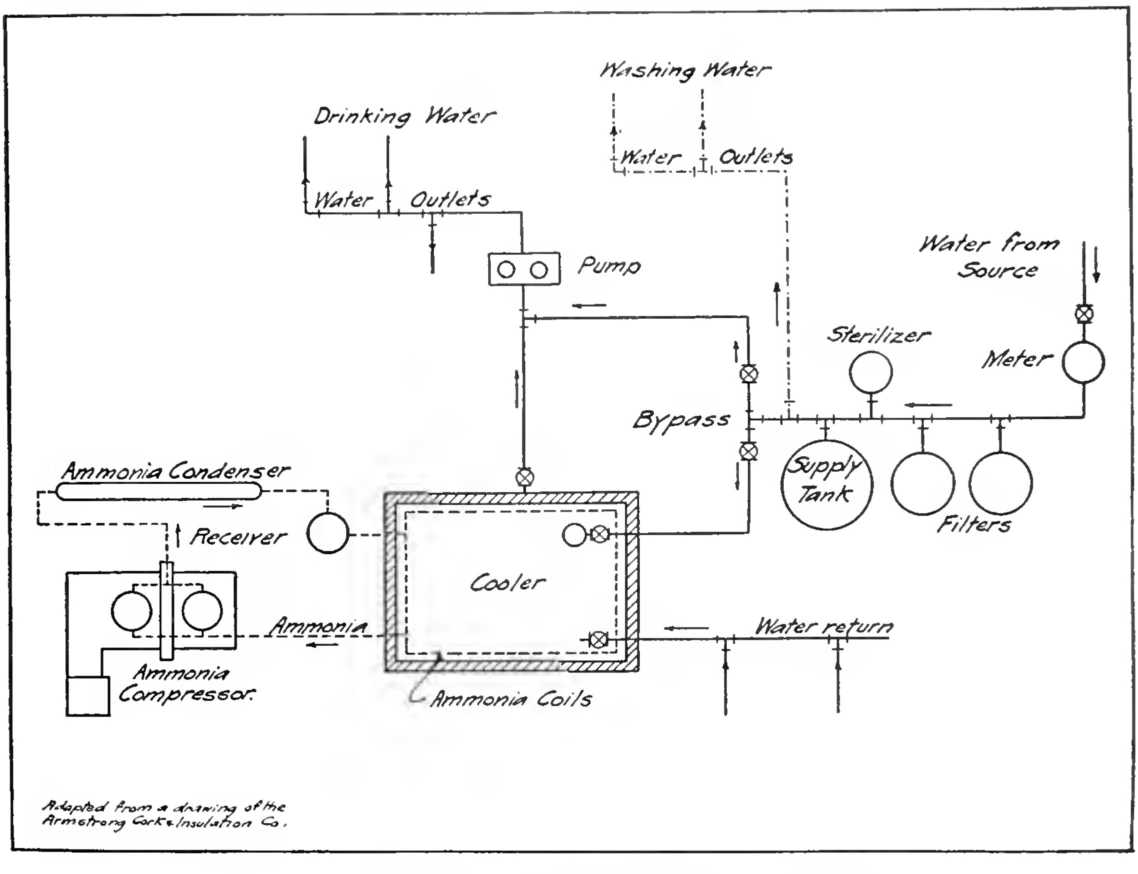

Fig. 8. — Drinking water cooling system and water purification plant.

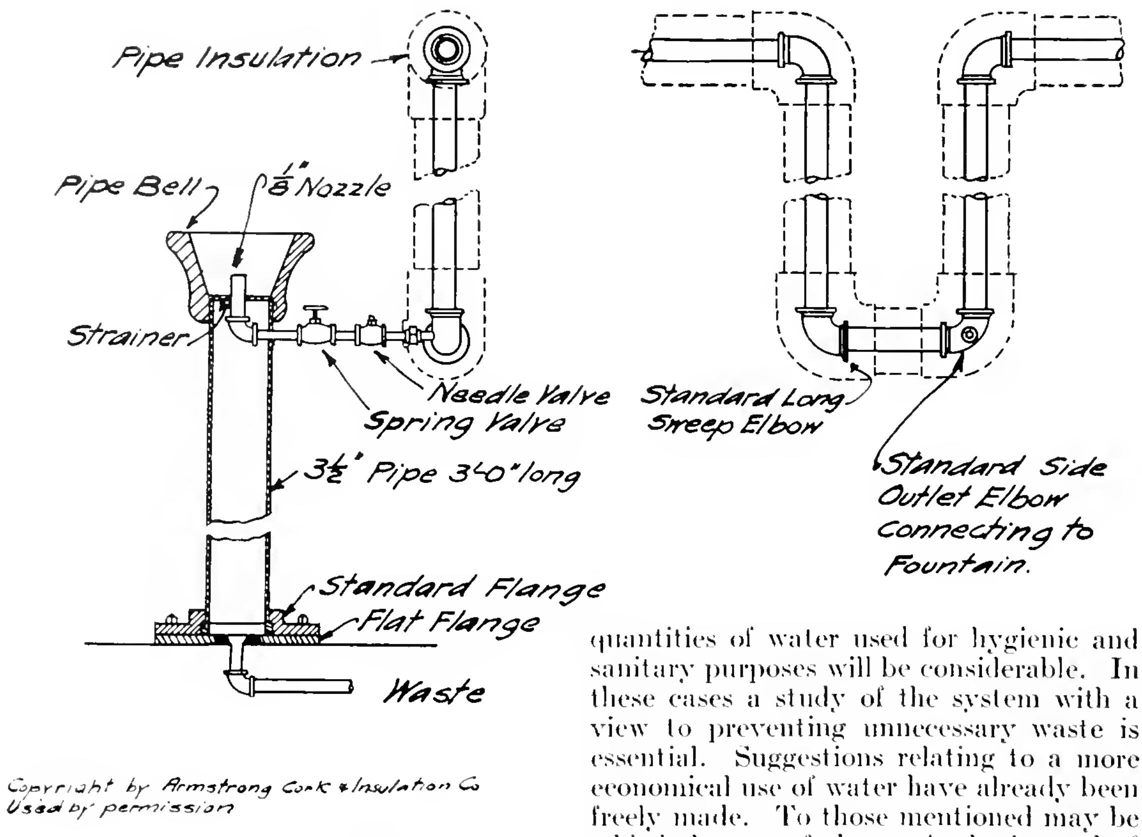

FIG. 9. — Sanitary drinking fountain.

both. The advantages of fixtures which enable the worker to wash in running water are evident. Nevertheless, some states require the use of individual bowls by law. A *reductio ad absurdum* in which the tub bath takes the place of the individual bowl and the shower bath that of the sink and running water makes the fallacy of such regulations evident. The only possible argument in favor of the bowl is its economical use of water, 2 gallons per capita daily being an ample supply. The use of running water, however, can be made less wasteful by using spray nozzles and, if warm water is used, by adjusting the temperature of the water in the main line instead of leaving this to the individual. Further saving can be effected by the use of foot pedals to control the flow of water, instead of regulating the same by the common faucet. A good arrangement is shown in Figure 10. This fixture consists of two cast-iron troughs placed back to back, enamel lined and painted on the outside. The faucets allow a clear space of 20 inches which permits the workers to get head and shoulders under the stream of water.

In large industrial establishments the quantities of water used for hygienic and sanitary purposes will be considerable. In these cases a study of the system with a view to preventing unnecessary waste is essential. Suggestions relating to a more economical use of water have already been freely made. To those mentioned may be added the use of shower baths instead of tub baths and the use of flush valves in place of the cistern system of flushing water closets. The use of flush valves alone, which is recommended by the state of New York, is not permitted in certain other states of the Union.

FIRE PROTECTION

It has already been suggested that the interconnection of pipe lines carrying polluted water for industrial purposes with the pure water system should be avoided. Dual connections of this type are unnecessary and are largely due to ignorance or carelessness. Connection, however, is often established with purpose between the fire-protection system and the pure water pipe lines of industrial establishments. A number of epidemics of water-borne diseases, however, have been traced to connections of this nature with polluted secondary supplies. Cases are on record in which only the employees of the establishment itself were affected (11), while others have occurred in which a whole city supplying water to an industrial plant has suffered. The most disastrous epidemic of the latter kind is perhaps that of typhoid fever which

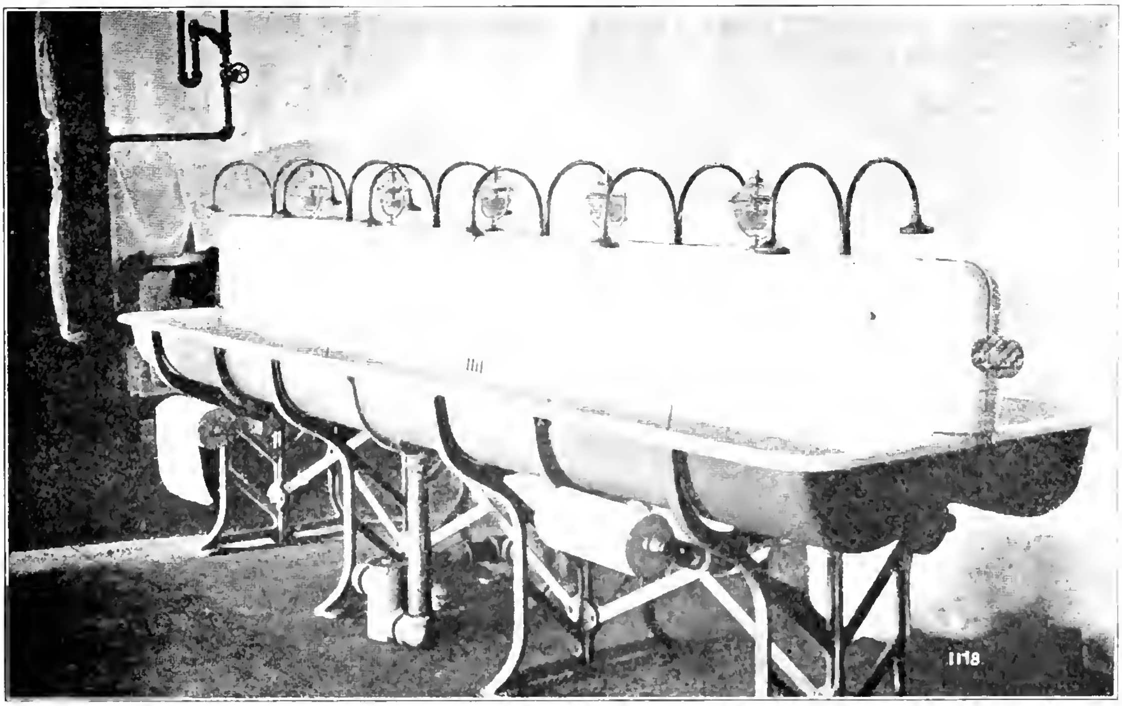

Fig. 10. — Double trough with spray faucets; non-scalding hot water; no stopper; liquid soap; and paper towels. (From Bulletin 250, U. S. Bur. Labor Statistics.)

occurred in Lowell, Mass., in the summer of 1903 (12). It has, therefore, often been advocated that laws be enacted to prevent the establishment of such dual connections. It would seem unfair, however, to forbid once and for all the use of fire-service connections, as conditions will arise where there is absolute necessity for the interconnection of the fire-protection line with the pure water system. Each case should be examined carefully and dual connections should be permitted only where it is impracticable to obtain any other type of fire-protection system. This, the writer is informed, is substantially the position taken by the Massachusetts State Department of Health.

The permission to establish the dual connection, furthermore, should be granted only upon the condition that an approved type of fire-service connection be installed. This connection usually consists of two check-valves and auxiliary apparatus as shown in Figure 11. The design of the check-valves is naturally the deciding factor in protecting the pure water system against contamination. A recent design by the Pratt and Cady Company under the direction of Mr. C. D. Rice is illustrated in Figure 12. All metal parts of this valve

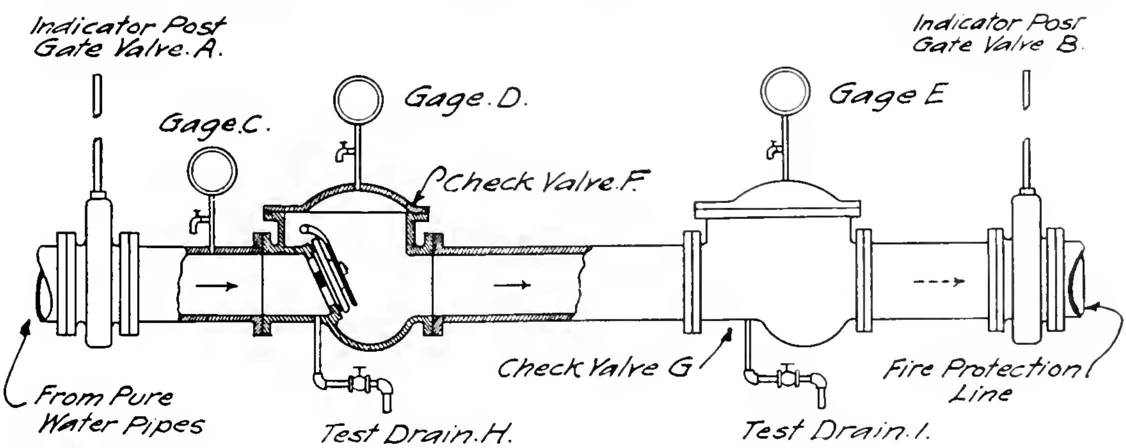

Fig. 11. — Fire-service connection and auxiliary testing apparatus.

are made of bronze which eliminates the factor of corrosion so important in certain water supplies. The kind of material needed, however, must depend upon the quality of water which is used in the service. Under favorable conditions cast iron that it is readily removed to permit the inspection of the interior of the valve.

Fire-service connections should be examined at frequent intervals, when the following tests may be applied to determine the tightness of the system. (See Fig. 11.)

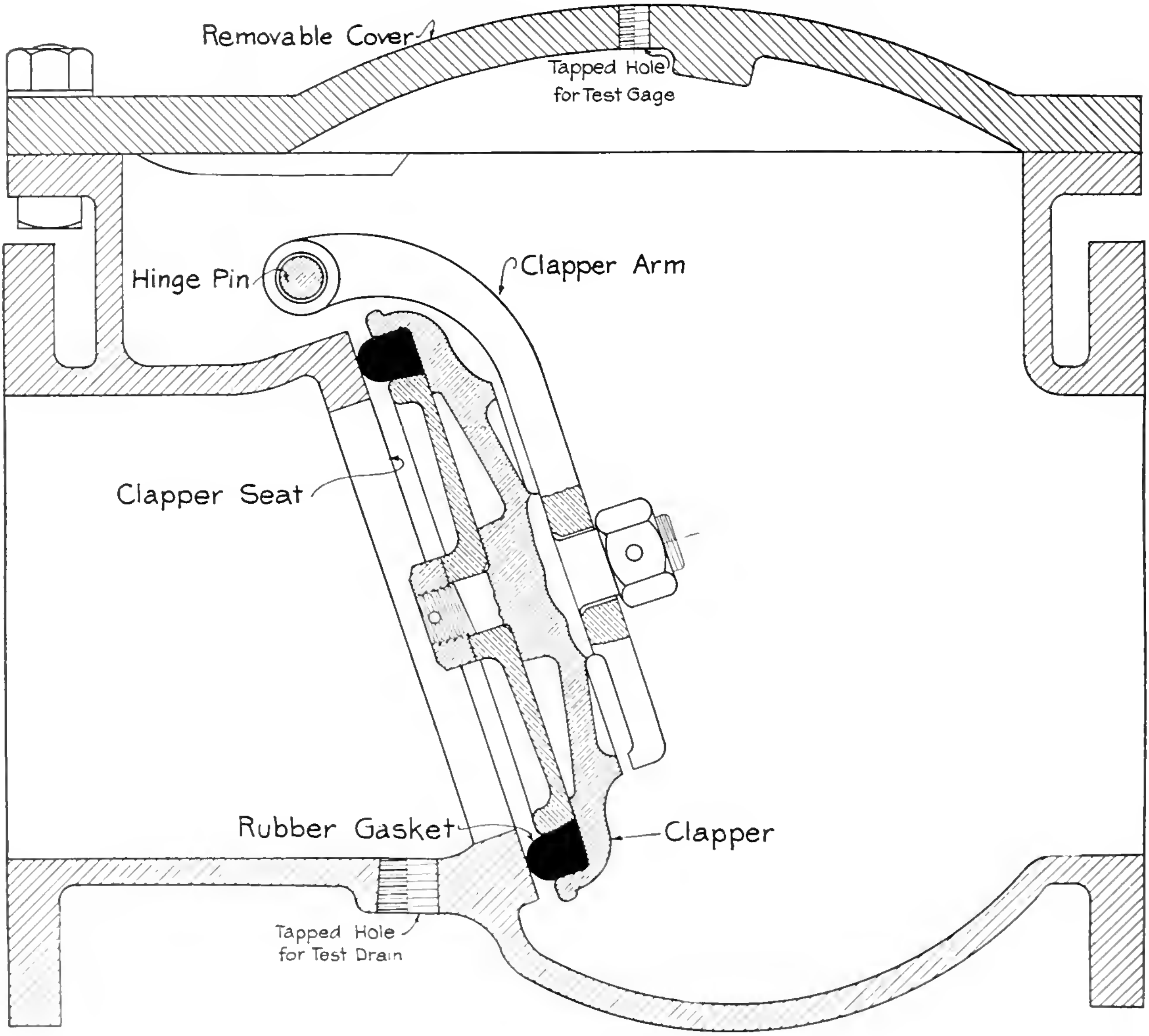

FIG. 12. — Bronze check-valve for fire-service connection.

may be substituted in all parts except the clapper and the seat. These should always be of bronze. A novel feature in the design is the type of rubber gasket employed, which it is believed will give greater satisfaction than the broad rubber facing of older designs. Ample clearances have also been established to insure the proper operation of the clapper, and pockets in which rust or sediment may collect have been avoided. The cover has been designed so

Close indicator post-gate-valve A, and open test-drain H. The reading on test-gage C should drop to zero, while the reading of gage D should remain unchanged. This will test the tightness of check-valve F. To test the tightness of check-valve G, open test-drain I. The reading on test-gage D should now drop to zero and the reading of gage E remain unchanged. Indicator post-gate-valves A and B are normally open.

If properly designed and rigidly inspected, these valves are almost absolutely safe. The use of double check-valve connections decreases the chances of contamination by the square of the probability of one valve being open. If, for example, the chances of one valve being out of order is one in 500, the chances of both being out of order at the same time will be one in 250,000. The inspection can be amplified by the use of a detectometer in the line.

Community Aspects

Inasmuch as the worker is exposed not only to the environment of the work place but also to the environment of the community in which he lives, the sanitation of industrial water supplies coupled with the many other health measures which may be effected in industrial establishments is of little value if at the same time the worker is endangered during his leisure hours by the use of unsafe water supplies and other agencies in defective community sanitation. To secure adequate health protection of workers, therefore, employers should bring their influence to bear upon the proper administration of the community at large.

Appendix

The Sanitary Design of a Typical Water-Supply System for Hygienic and Sanitary Purposes

It has been suggested before that the design of a good drinking-water system is strictly an engineering problem. The statement, however, does not imply that the problem can only be solved by trained engineers. For the guidance of the interested reader, some of the details of a typical case are explained below. The example was first suggested to the writer by a booklet, *Drinking Water Systems* (14), in which a concrete example is worked out, the method of which in part forms the basis of the following computations.

Let us assume that we are to supply water for hygienic and sanitary purposes to two buildings, one housing the office force of 100 people, the other, the shop force of 1000 people in an industrial plant. One drinking-water circuit, 1000 feet long, supplies the office building; the other circuit, 4000 feet long, supplies the shop building. The supply main leading from the purifying and cooling plant to these two circuits is 200 feet long. The length of the washing-water system is not considered, as the supply line is under sufficient pressure for all needs. The water is polluted. Its maximum summer temperature is 75° F.; that of the treated water is to be 55° at the supply end of each circuit, rising to a maximum temperature of 60° at the return end of the circuit. The maximum temperature of the office building for any length of time is 90°; that of the shop, 95°. Assume an eight-hour working day.

Drinking Water

Circuit 1

Number of people supplied, 100.

Amount of water (including waste) required per person per hour = 0.25 gallons.

Amount of water for circuit in 8 hours = $0.25 \times 8 \times 100 = 200$ gallons.

Length of pipe line, 1000 feet.

Difference between room and water temperatures $(90 - 55) = 35°$ F.

Allowable rise of temperature in circuit $(60 - 55) = 5°$ F.

Assume a $\frac{3}{4}$-inch pipe line will be used.

Internal cross-sectional area of $\frac{3}{4}$-inch pipe = 0.0037 square feet. From Table 1.

Heat absorbed by one lineal foot of $\frac{3}{4}$-inch pipe per 24 hours per degree difference in temperature when insulated with some standard covering (Table 1) = 4.00 B. T. U.

Heat absorption of circuit in 8 hours = $\frac{4.00}{42} \times 8 \times 1000 \times 35 = 46{,}700$ B. T. U.

One B. T. U. will raise one pound of water 1° F.

Therefore, amount of water required to insure an allowable rise of temperature of 5° F. = $\frac{46700}{5} =$ 9340 pounds = $\frac{9340}{8.33} = 1120$ gallons.

This result might have been obtained by using Table 1, Column 7.

Quantity of water required for 1000 feet of pipe for 35 degrees difference in temperature in 8 hours to keep heat rise to 5° = $.096 \times 1000 \times \frac{8}{24} \times 35 =$ 1120 gallons.

1120 gallons (water required to keep temperature within prescribed limits) + 200 gallons (water used including waste) = 1320 gallons.

It is therefore necessary to circulate 1320 gallons in 8 hours or $\frac{1320}{8 \times 60 \times 60 \times 7.48} = 0.00613$ cubic feet a second.

$$\text{Velocity} = \frac{\text{Quantity}}{\text{Area}} = \frac{0.00613}{0.0037} = 1.65 \text{ feet per second.}$$

This is an economical velocity, a common figure being 3–4 feet per second.

Circuit 2

Number of people supplied, 1000.

Amount of water for circuit in 8 hours = $.25 \times 8 \times 1000 = 2000$ gallons.

Length of pipe, 4000 feet.

Difference between room and water temperatures (95 − 55) = 40° F.

Allowable rise of temperature in circuit (60 − 55) = 5° F.

Assume a $1\frac{1}{4}$-inch pipe line will be used.

Internal cross-sectional area of a $1\frac{1}{4}$-inch pipe = 0.0104 square feet.

From Table 1, Column 7:

Quantity of water required for 4000 feet of $1\frac{1}{4}$-inch pipe for 40 degrees difference in temperature in 8 hours to keep heat rise to 5° F. = $.115 \times 4000 \times 40 \times \frac{8}{24}$ = 6150 gallons.

TABLE 1.—REFRIGERATION DATA

Nominal Size	Internal Transverse Area		Heat Transmitted* per Lineal Foot per Degree Difference in 24 Hours		Quantity of Water Required per Foot per Degree Difference in 24 Hours to Keep Heat Rise to 5° F.	
	Nominal	Standard Wrought Pipe	Bare Pipe B.T.U.	Insulated Pipe B.T.U.	Bare Pipe Gallons	Insulated Pipe Gallons
Inches	Sq. In.	Sq. In.				
(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\frac{1}{2}$	.196	.304	9.50	3.84	.228	.092
$\frac{3}{4}$	.442	.533	11.88	4.00	.285	.096
1	.785	.864	14.81	4.26	.356	.102
$1\frac{1}{4}$	1.227	1.495	18.77	4.78	.450	.115
$1\frac{1}{2}$	1.767	2.036	21.49	5.27	.516	.126
2	3.142	3.355	26.80	5.88	.643	.141
$2\frac{1}{2}$	4.909	4.788	32.46	6.98	.779	.167
3	7.069	7.393	39.58	7.30	.950	.175
$3\frac{1}{2}$	9.621	9.886	45.24	7.82	1.09	.188
4	12.566	12.730	50.89	8.29	1.22	.199
$4\frac{1}{2}$	15.904	15.947	56.55	9.20	1.36	.221
5	19.635	20.006	62.88	9.84	1.51	.236
6	28.274	28.891	74.87	10.49	1.80	.252
7	38.485	38.738	86.18	12.05	2.07	.289
8	50.265	50.027	97.49	11.41	2.34	.274
9	63.617	62.786	108.80	14.62	2.61	.351
10	78.54	78.855	121.56.	14.79	2.92	.355
12	113.1	113.097	144.20	19.98	3.46	.480

* Values for Nonpareil Cork covering, Armstrong Cork & Insulation Company.

It is therefore necessary to recirculate 6150 + 2000 = 8150 gallons in 8 hours, or

$$\frac{8150}{8 \times 60 \times 60 \times 7.48} = 0.0378 \text{ cubic feet a second.}$$

Velocity = $\frac{\text{Quantity}}{\text{Area}} = \frac{0.0378}{0.0104}$ = 3.6 feet per second.

Mains

Assume a $1\frac{1}{4}$-inch line is necessary to supply the two branch circuits.

Internal cross-sectional area of pipe = 0.0104 square feet.

Supply Line

Length of line, 200 feet.

Quantity of water carried, 1320 + 8150 = 9470 gallons in 8 hours.

0.0061 + 0.0378 = 0.0439 cubic feet per second. 9470 × 8.33 = 78,800 pounds.

Velocity = $\frac{0.0439}{0.0104}$ = 4.2 feet per second.

Difference in room and water temperatures (90 − 55) = 35°.

Heat absorption of supply line = $4.78 \times \frac{8}{24} \times 200 \times 35$ = 11,200 B. T. U.

One B. T. U. will raise one pound of water 1° F.

Therefore 11,200 B. T. U. will raise 77,300 pounds of water $\frac{11200}{78800}$ = .14° F.

Amount of heat absorbed in supply line = 0.14° F.

The temperature of the water leaving the cooler must therefore be 54.86° to insure a temperature of 55° at the entrance to the branch circuits.

Return Line

The return line operates under practically the same conditions as the supply line with the exception that the amount of water carried is 1120 + 6150 = 7270 gallons, and the difference in room and water temperatures is (90 − 60) = 30°.

Amount of heat absorbed in return line = $.15 \times \frac{9270}{7270} \times \frac{30}{35}$ = 0.16° F.

The temperature of the returning water at the cooler is therefore 61.16° F.

Required Refrigeration

Make-Up Water.—Amount of make-up water 200 (circuit 1) + 2000 (circuit 2) = 2200 gallons = 18,300 pounds.

Temperature before cooling = 75° F.; after cooling 54.86° F.

Heat removed in 8 hours = 18,300 × 20.14 = 369,000 B. T. U.

Return Water.—Amount of return water, 1120 (circuit 1) + 6150 (circuit 2) = 7270 gallons = 60,500 pounds.

Temperature before cooling, 60.16° F.; after cooling, 54.86° F.

Amount of cooling necessary (60.16 − 54.86) = 5.30° F.

Heat removed in 8 hours 60,500 × 5.30 = 321,000 B. T. U.

Entire System.—Total heat removed in 8 hours, 369,000 + 321,000 = 690,000 B. T. U.

One ton of refrigeration = 284,000 B. T. U.

Refrigeration necessary = $\frac{690,000}{284,000} \times \frac{24}{8}$ = 7.29 tons per 24 hours.

This, however, does not include the cooling necessary to overcome heat absorption of pumps, tanks, etc., which is in part compensated by the fact that the difference between room and water temperatures is not as great as assumed throughout the system.

Purification System

Assume a consumption of 10 gallons per person for hygienic and sanitary purposes other than drinking.

Water used for drinking purposes = 2200 gallons in 8 hours.

Water used for other purposes = 11,000 gallons in 8 hours.

Total amount to be purified = 13,200 gallons in 8 hours.

Filters. — Assume a rate of filtration of 2 gallons per square foot per minute.

Filtering area required, assuming a uniform use of the filter, $\frac{13,200}{8 \times 60 \times 2} = 13.8$ square feet.

Clear Water Tank. — Since a uniform draft of water cannot be expected, a clear water tank sufficient in capacity to take care of the maximum draft must be installed. Assuming that 25 per cent. of the water used for sanitary purposes is used at the noon hour and at the end of the day respectively, the capacity of this tank must be $11,000 \times 0.25 = 2200$ gallons.

Coagulation. — Assume that 1 grain per gallon of alum will be sufficient to free the water from color and turbidity by subsequent filtration. 7000 grains = 1 pound.

Amount of alum used per day $= \frac{13,200}{7000} = 1.9$ pounds.

Reduction of alkalinity of water by adding one grain of alum is approximately 7 p.p.m.

Since the alkalinity of the water should not be reduced below 10–15 parts per million, this would require an initial alkalinity of 17–22 parts per million, approximately, or an addition of washing soda sufficient in amount to insure a residual alkalinity of 10–15 parts per million.

Disinfection. — (*a*) *Liquid Chlorine:* Assume that 0.5 parts per million of chlorine are sufficient to disinfect the water.

0.5 parts per million $= \frac{0.5 \times 13,200 \times 8.33}{1,000,000} =$ 0.055 pounds per day.

(*b*) *Hypochlorite of Lime:* Assume 30 per cent. available chlorine.

Amount used per day $= \frac{0.055 \times 100}{30} = 0.18$ pounds.

Planning for the Future

In planning a water-supply system for an industrial plant, the design should look towards the future needs of the factory while considering those of the present. The allowances made for future growth will naturally vary with each individual case.

Equivalents and Other Useful Information

A gallon of water (U. S. standards) weighs 8.3 pounds.

A cubic foot of water contains 7.48 gallons and weighs 62.5 pounds.

One grain per gallon is equivalent to 17.1 parts per million or 142 pounds per million gallons.

One grain per gallon of alum is equivalent to 7.7 parts per million of alkalinity ($Ca\ CO_3$).

One grain per gallon of alum is equivalent to 8.2 parts per million of soda ash or 4.3 parts per million of lime.

One grain per gallon of ferrous sulphate is equivalent to 6.2 parts per million of alkalinity ($Ca\ CO_3$).

One grain per gallon of ferrous sulphate is equivalent to 6.2 parts per million of alkalinity ($Ca\ CO_3$).

One grain per gallon of ferrous sulphate requires 6.9 parts per million or 57 pounds per million gallons of lime.

Hypochlorite of lime is equivalent to 30–35 per cent. of available chlorine.

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BOOK REVIEWS

Otis Group Intelligence Scale: A Point Scale, with Manual of Directions. By Arthur S. Otis. Paper, pp. 38. Yonkers-on-Hudson, N. Y.: World Book Co., 1919. Accompanied by Tentative Table of Norms, Formula for Comparing Scores with Scores by Alpha Examination (American Army Intelligence Scale), Test Sheets and Blanks, and Examiner's Key.

The Otis Group Intelligence Scale is a simple, clear, and practical method of measuring intelligence by group examination, by which one examiner can test a great number of individuals in a short time. Professor Terman in an introductory note explains that it would naturally be followed by further testing by the Binet-Simon individual method in all exceptional or complicated cases. The tests are ten in number, and full directions are given for making the tests; for scoring and computing intelligence quotient, mental age, percentile rank, and coefficient of brightness; and for changing the score to that of the Alpha test of the Army. The tests may be used with adults as well as with children, but an education to about the extent of the first four grades of school is necessary. All the tests, with perhaps one exception, are such as avoid the use of specific schoolroom content and they comprise: following directions; opposites; disarranged sentences; proverbs; arithmetical tests; geometrical figures; analogies; similarities; narrative completion; memory.

In the form in which these tests are now presented they appear to be available for several purposes, and in several particulars they are superior to other methods of examination of the intelligence. They have evidently been planned especially to meet the needs of examiners who are not specialists in psychological work, and although the explanations are brief, they are complete and very clear. If the examiner has any scientific instinct whatever, he can hardly go wrong. The methods of tabulation have been very well worked out, and with a little practice any intelligent person ought to make with these materials reliable group tests. Their limitation, so far as their use by the industrial psychologist is concerned, is the extent to which they depend upon a knowledge of the English language, which is considerably more than is indicated by the school year when the tests first are applicable, since some of the tests seem to require a native appreciation of the language. The Beta tests of the Army, or one of the adaptations of this method, would need to be added to the equipment of the industrial examiner. —*G. E. Partridge.*

NOTICE

Industrial Nursing

There has been a definite expression of opinion recently among industrial nurses generally that there is need for uniform standards of service and for better preparation for their work. Employers are seeing similar needs. Industrial nursing is still a field for the pioneer nurse who often takes up her work without thought of preparation other than a hospital training. She finds immediate need for a broader knowledge, which is often fairly easy to obtain if the way is pointed out.

The industrial nurses of the National Organization for Public Health Nursing plan to form an Industrial Nursing Section in the national organization at the meeting in Atlanta next April. The object of this section will be the formulation and maintenance of high standards for service in industry. It is planned to make known to nurses throughout the country the opportunities for education for industrial nurses. Opportunities exist or may be developed in many large centers.

Membership in the National Organization for Public Health Nursing

Qualified nurses are eligible to membership. Employers are eligible to corporate membership. Associations of employers, of employers and workers, or of employees, are eligible to corporate membership.

All industrial nurses are urged to attend the Atlanta meeting and employers of industrial nurses are urged to send a nurse as their representative. If she becomes an active member, she will have a vote. In any case, she will learn what other industrial nurses are doing and she will return to her duties with renewed energy and inspiration.

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INDUSTRIAL DISEASES UNDER THE MEDIAEVAL TRADE GUILDS*

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THE last thing I should claim would be to be called an archaeologist. But this is not to say that I am not intensely interested in bygone times, and do not fervently admire the perfection of work wrought in stone, metal, wood and textiles under the totally different conditions of life, employment, and, shall I say, spirit, which prevailed in the Middle Ages. In England and in Scotland, to say nothing of the continent, one is brought up against what has been left of this life in almost every town and village — in cathedral, parish church, guild hall and country cottage, with all that they contain of craftsman's skill in the service both of God and man. Nowhere in Europe and at no time, scarcely, can one escape the feeling of bygone generations at work on materials of which they were the masters, adapting themselves with difficulty to changed circumstances, as conservative in their craft rules as they were free in their style and tastes; and living a corporate life under the guardianship of the municipalities, in guilds or fraternities which exercised a rigid supervision over the whole conduct of the individual.

Although this close monopoly which the trade guilds sought to maintain in each township, by limiting the number of apprentices, visiting with dire pains and penalties the "strangers", as they called those artificers who settled in towns in which they had not served their term, ultimately led to their undoing; yet before this happened, the system had served its time well — a time when communication of one country, nay, of one town with another was limited, when the desire to pile up money was not the aim and object of every right-minded man, and when capital did not spread its tentacles to and take toll of all the corners of the earth.

Living in a country which was the cradle of the guild system, in which that system was the living force of industry for 500 years, and in which one still tries to make believe that something of that spirit remains, I have sought at times to picture to myself the kind of life that was led, to visualize the craftsman at his work, and to sympathize with him in the industrial diseases from which he suffered; for, believe me, as I shall attempt to show you, he must have suffered from them far more than his prototype does to-day. With the object, then, of paying homage to our great forerunners in the game of life, of seeing what we can learn of them and their methods in industry that will profit us to-day and not with any idea, as you can well imagine, of trying to put the clock of the world back, I have prepared these two lectures.

In looking through the charters of guilds of no matter what craft, and from no matter what town or country, in the earliest, as well as the latest, you find stress almost invariably laid on three outstanding points:

1. Assistance to sick and poor members.
2. Honest work, as shown in their system of inspection or, as they called it, "searching."
3. Pride in their work, and in their guilds, as shown in their processions, their guild halls, and their contributions to chapels and chantries.

* Lowell Institute Lecture, delivered in Boston, Mass., Nov. 24, 1919. Received for publication Nov. 25, 1919.

So much is there to be said, that I will speak only of the first to-day, and of the second and third in my next lecture.

The craft guilds were the only friendly societies, benefit societies and sick societies, that existed in their times. Thus, in the charter granted by King Richard II to the Gild of the Peltyers (furriers) in Norwich, "it is ordeyned . . . yat quat broyer or syster, be goddis sonde, falle in mischefe or mys-ese, and have nout to helpen hemselfe, he schal han almesse of eueri broyer and syster euery woke, lastende his myschefe. . . . But if it be his foly, he schal nout han of ye elme." The last point, you see, shows that the early guilds were up against the same difficulty that the latest state insurance acts have been, namely, how far can an illness, wilfully or culpably brought on himself by a man, become matter for compensation. The Carpenter's Guild goes a little further, and tacks on "ryotous lyvyng" to "folye," as a reason for exclusion from benefit.

The Guild of the Smiths of Chesterfield draws a distinction between the treatment of the sick and of the poor because the ordinance says: "If any brother is sick and needs help, he shall have a halfpenny daily from the common fund of the gild, until he has got well. If any of them fall into poverty, they shall go, simply, on given days, to the houses of the brethren, where each shall be courteously received, and there shall be given to him, as if he were the master of the house, whatever he wants of meat, drink and clothing, and he shall have a halfpenny like those who are sick; and then he shall go home in the name of the Lord."

Respect for the dead, too, is solemnly enjoined by a procession of the members of the guild at the funeral, burial service, and by offerings at mass.

We have to think of the trade guilds as societies of workmen in one trade, of masters and apprentices under one elected warden, and officers who kept registers of members and minute books of expenses, delinquencies, fines, and transactions — the whole guild being bound by certain customs and ordinances. The system was largely founded on family life. The master was allowed to bring up his children in his trade, but he was only permitted to have one apprentice, who had to be formally inscribed, had to sign on for seven years during all of which time he had to live as one of the family in the house of his master, sharing his food and the family life. Hours of work were very long, from 5 o'clock in the morning in winter and 6 in summer to 7 at night, with perhaps three hours off for meal-times.

In the fifteenth century hours depended much on the amount of daylight, and varied, excluding meal-times, from seven to thirteen hours. Work by artificial light was often prohibited. The desire to shorten the working day showed itself early, and in some ordinances we find work forbidden on one half-day a week. Holidays were fixed by the church festivals of which there were plenty. In all there were 275 working days in the year. Work was forbidden on Sundays, on holy days, and on the evenings before them.

The apprentice had usually to be indoors by 9 o'clock at night. "Boys will be boys," and stern measures were often necessary to preserve quiet and peace in the streets, and to ensure that the apprentices went to bed betimes. The lot of the foster child is proverbially a hard one, and in many cases that of the apprentice, obliged to sleep anywhere and to be one of a family to which he did not belong, must have been irksome in the extreme. And his apprenticeship lasted for seven years, as a rule, after which, on performance of his *chef d' oeuvre*, testifying to his ability as a craftsman, he became worthy to be admitted, with all due forms and ceremonies, into the great fraternity of master craftsmen. With what longing must he have looked forward to that day, and with what pride must he have grasped, on his election, the hand of fellowship extended to him by the warden. Is there, in the early life of the workman to-day, anything so likely to mark such a red-letter day, or to make such an epoch in his career as this day of admission as a master craftsman, in the life of an apprentice in the time of the mediaeval guilds?

Now, while the modern factory system has changed industry very much, it has not, in the main, changed the materials used, except in industries dependent on our greatly advanced knowledge of chemistry. Some processes, especially during the last thirty years, have been made much safer, mainly through the application of locally applied ventilation, by means of fans for the removal of dust and fumes; others, no doubt, have been made much more dan-

gerous by the introduction of machinery and by the speeding up of that machinery, of which we constantly hear so much, by the size and scale of the operations and by the lifting tackle and means of transport required. These have brought about great changes in the life of industry, but not the greatest change of all. That change is a difference of taste and of appreciation of beauty; of this I shall speak more later. What concerns me to-night is to compare the healthiness of the processes as carried on in the two periods — in the time of the trade guilds, and in modern times.

If lead and mercury when used to-day cause illness, did not they do so five hundred years ago, when quicksilver certainly must have been used in the arts far more than it is to-day? And will not the same hold good of the work of the stone-mason, and the effect on his lungs of the sandstone dust; in that of the preparer of flax, with the extremely primitive methods by which this was done; in lead glazing of pottery, and in the making of armor?

Many sidelights are thrown on industrial diseases by writers of the Middle Ages. Does not the Chanoun's Yeoman of one of Chaucer's tales, in describing with minute detail the Alchemist's effort to find the Philosopher's Stone, say of his own experience:

> "Al that I hadde, I have y-lost ther-by;
> And god wot, so hath many mo than I.
> Ther I was wont to be right fresh and gay
> Of clothing and of other good array,
> Now may I were an hose upon myn heed;
> And wher my colour was bothe fresh and reed,
> Now is it wan and of a leden hewe;
> Who-so it useth, sore shal he rewe.
> And of my swink yet blered is myn ye."

But fortunately we do not have to rely on scattered references, because we have a complete work on the *Diseases of Artificers and Tradesmen*,* which was published in 1700 by Bernardino Ramazzini, then Professor of Medicine in Modena, and later in Padua. Ramazzini was, thus, collecting materials for his work about fifty years after William Harvey published his book on the *Circulation of the Blood* which, from the references he makes to the circulation, he must have known. Books on industrial diseases in those days seem to have sold like hot cakes — much better than they do now — for a second edition was soon called for, in which several additional chapters appeared. The value of Ramazzini's book lies in the fact that it was written just at the time of the parting of the ways in industry and medicine, when both were about to make greater strides in the next fifty years than they had done in the preceding five hundred years.

It was from members of craft guilds that Ramazzini derived his information, and he describes how he was obliged, in prosecution of his design, "to visit all the workhouses of Artificers, in order to get a clear view of the occasional causes of their diseases" because "the Shops or Workhouses of Tradesmen are the only Schools in which we can find any satisfactory knowledge of these matters." His book was translated into terse English as early as 1705 by that Dr. James, the friend and schoolfellow of Dr. Samuel Johnson, whose fame otherwise rests on his prescription for the well-known James's Powders, and it is from his version I quote.

What is the picture Ramazzini paints for us? Illuminating, certainly, if we read between the lines. In his preface he soundly observes — and I would preface my quotations from him by letting you know he calls a spade a spade and not an agricultural implement — that a doctor should not only ask his patient "What uneasiness he is under. . . . What was the cause of it. . . . How many days he has been ill. . . . How his belly stands. . . . What food he eats," but also "What trade he is of?" And, indeed, occupation is the most potent of all causes of incapacity.

In his preface, too, Ramazzini has a delightful reference to you which I cannot forbear quoting in spite of the warning in that incisive essay by Charles Russell Lowell, which every visitor to the United States from Europe should read, entitled *On a Certain Condescension in Foreigners:*

> "If we consider what a vast difference there is between the Europeans and the Americans, and other barbarous nations of the New World, we can't but be sensible that mechanik arts have contributed very much towards the civilising of mankind."

Shade of Ramazzini! If you could be here to-day, would you not recant somewhat of that sentence?

The book treats discursively in forty-

* No useful purpose would be served by republishing Ramazzini's book. I have, however, sought to quote the principal extracts which seem to me still to have a bearing on industrial hygiene to-day. Two copies of the volume are in the Surgeon General's Library, Washington, D.C.

three chapters of practically all trades and professions. Those that have most interest to us deal with metalliferous workers, chemists, glass-makers, potters, painters, dyers, tanners, bakers, millers, stone-masons, flax and silk workers. He spreads his net wide enough to include barbers and surgeons, nurses, Jews, porters, grooms, wrestlers, musicians, husbandmen, and learned men. He leaves out little except ship-building and the manufacture of high explosive shells.

The goldsmith's art was exercised, as you know, in the gilding of ornaments and images for church and home decoration; this was done on an unexampled scale by means of a gold-mercury amalgam. Mercury or quicksilver is one of the most powerful and subtle poisons, the use of which, in industry, has now been much reduced, most fortunately, by the substitution of the nitrate of silver and ammonia process for it in the silvering of mirrors and by electro-plating. The old method applying an amalgam of mercury and silver or mercury and gold was very dangerous for the mercury had to be driven off by heat, thus exposing the worker to the inhalation of the noxious fumes. Occasionally, even now, one still finds silver and gold applied in the same old way, with attempt made to remove the fumes by a flue. And wherever metallic mercury is used, as in the making of clinical thermometers, still carried on in Clerkenwell very much as a home industry, the same evidence of the insidious absorption of mercury is found, showing itself clinically by tremulousness of the hands, inflammation of the gums with blackened and loosened teeth, and cadaverous complexion.

FIG. 1. — Goldsmiths' workshop, showing furnace on right. (*Fifteenth Century. From "Der Handwerker."*)

Clinical signs do not change, and we can, therefore, picture to ourselves the condition and appearance of many a craftsman in the Middle Ages, who carried out and produced the decorative work we so much admire to-day, for in discussing the effect of minerals Ramazzini says:

"If we move from the Mines, and the Beating, Melting, and Refining Work-Houses, to the Cities themselves, even there we'll meet with Workmen that suffer by the influence of Minerals. 'Tis well known what dismal Plagues are inflicted by Quick-silver upon Goldsmiths, and chiefly those who are imployed in Gilding Silver or Brass Work; For as this Gilding can't be performed without Amalgamation (i. e., the Corrosion of the Mettal by Mercury), so when they afterwards come to dislodge this Mercury by Fire, tho they turn away their Faces, they can't possibly avoid the receiving some poysonous Steams at the Mouth, and accordingly we find that this sort of Workmen do quickly become Asthmatick, Paralytick and liable to Vertigo's; and their complexion assumes a dangerous Ghostly Aspect. Few such Workmen continue in that way to old Age; or if they do not die betimes, their Condition becomes so miserable, that Death is all their wishes. Their Neck and Hands tremble, their Teeth fall out, their Legs are weak and maul'd with the Scurvy. . . . I had Occasion my selfe not long ago to see a young Man, a Gilder, that dy'd after two Months confinement to his Bed; having taken too little care to avoid the Mercurial Exhalations. For they threw him at first into a Cachectick Habit of Body; after that his face became wan and of a Carrion complexion, his Eyes swell'd, his Breathing became difficult, and his Mind stupid, and an inactive lazy Drowsyness seiz'd his whole Body. He had fetid stinking Ulcers in his Mouth, which voided incessantly a very great quantity of ugly nasty Matter."

Ramazzini's explanation of the way in which mercury is absorbed and acts is sound, although expressed strangely to our modern ears.

"The Texture and Fabrick of the Quick-Silver being dissolv'd by the violence of the Fire, 'tis reduced to such minute Particles, as penetrate to the Lungs, Heart and Brain, upon their being receiv'd at Mouth and Nostrils. By this means 'tis inabled to cloud the animal Spirits with more Facility, and strike the whole Mass of Fluids with a narcotick Dullness."

Of another industry as ancient as any — pottery — Ramazzini describes the processes very much as they are carried on to-day. Thus:

"There 's scarce any City in which there are not other Workmen, besides those mention'd above, who receive great prejudice from the Metallick Plagues.

Among such we reckon the Potters; for what City, what town is without such as practise that the Ancientest of all Arts? Now, the Potters make use of burnt and calcin'd Lead for glazing their Ware; and for that end grind their Lead in Marble Vessels, by turning about a long Piece of Wood hung from the Roof, with a square Stone fasten'd to it at the other end. While they do this, as well as when with a pair of Tongs they daub their Vessels over with melted Lead before they put 'em into the Furnace; they receive by the Mouth and Nostrils and all the Pores of the Body all the virulent Parts of the Lead thus melted in Water and dissolv'd and thereupon are seiz'd with heavy Disorders. For first of all their Hands begin to shake and tremble, soon after they become Paralytick, Lethargick, Splenetick, Cachectick and Toothless; and in fine, you'll scarce see a Potter that has not a leaden Death-like Complexion. In the *Acta Haffniensia* an Account is given of a Potter in whose dissected Corps the right Lobe of the Lungs was found grown to the Ribs and tending to a wither'd dryness and a Phthisick; this Indisposition of his Lungs being attributed to the Trade he had work'd at; for the Patient had been bred to the Potter's Trade, and finding it unhealthful had left it off, tho not time enough."

In this brief description, Ramazzini gives the salient symptoms of the double danger of the potter's work — lead poisoning, showing itself in paralysis, and "potter's rot", in fibroid phthisis. He is quite clear in his distinction between the different processes, and tries to bring this out by saying:

"I could not forbear joining Admiration to my Curiosity, when the Enquiry how it came to pass that Earthen Ware first boil'd in the Furnace, then cover'd with Lead calcin'd, pounded with the Powder of Flints and melted, and thus put into the Furnace again, did assume by the influence of the Fire, that Glassy Crust that renders them so serviceable in all the uses of Life."

"In the mean time we must take Notice, that there are several different sorts of Workmen in a Potters Workhouse; some of whom are imployed in Working of Chalk with their Hands and Feet; and others in forming the Vessels by Sitting and Turning a Wheel. So that all who go by the Name of Potters are not subject to the Diseases before-mention'd, and therefore care must be taken that when ever the Name of a Potter is heard, we do not presently administer the Remedies calculated to correct the injuries of the Mineral Matter. However, this may be said of 'em all in General, that as they all spend their Lives in moist Places, and are still imploy'd in Handling moist Earth, so they are for the most part wan Complexion'd and Cachectick, and a'most always complaining of some illness or other. Those who sit at the Wheel and form the Vessels by turning it about with their Feet, are apt to have a swimming in the Head, if their Eyes are otherwise weak; and oftentimes the over tyring of their Feet makes 'em subject to the Sciatica; and therefore we ought to assist 'em with the Remedies prescrib'd by Practitioners in such Cases; which if they do not extirpate, will at least soften and mitigate the Disease."

Ramazzini gives us an insight into the risks of painting in passages full of chatty gossip and a banal philosophy, culled from old writers to whom he paid extraordinary deference.

"Painters are also usually subject to various Disorders, such as the Tremblings of the Joynts, a Cachexy, a Blackness of the Teeth, a discolour'd Complexion, Melancholy and loss of Smelling: For it seldom happens that the painters who use to draw the Pictures of others handsomer and better Complexion'd than the Originals, are themselves either handsome or well Complexion'd. For my part I have always observ'd that all the Painters I know either in this or other Towns, are a'most always

FIG. 2. — Polishing armor, showing curtain to protect against sparks and dust. (*Sixteenth century. From "Der Handwerker."*)

sickly; and if we consult the Histories of Painters, we'll find they were not long-liv'd; especially if we confine our view to such as made a distinguishing Figure. History informs us that Raphael Urbinus, a very famous Painter, was snatch'd away in the very Flower of his Age; and Balthasar Castilioneus condol'd his untimely Death in a very pretty Poem. 'Tis true, the Diseases of this sort of men may be imputed to their sedentary Life, and the Melancholy that feeds upon 'em, while they retire from human Society and bend all their thoughts upon their Phantastick Idea's. But the principal Cause of their Sicklyness is the Matter of the Colours that 's always among their Hands, and under their Nose; I mean the Red Lead, Cinnabar, Ceruss, Varnish, Oil of Wallnuts, and Oil of Linseed, with which they temper their Colours, and several other Paints made of various Minerals. Hence 'tis that their Shops have such a nasty stinking Smell, which is chiefly owing to the Varnish and foresaid Oils, and is very offensive to the Head; and perhaps the loss of Smell usual among Painters flows from no other Cause. Be-

sides, when the Painters are about their Work, they have nasty daub'd Cloaths upon 'em, that they can't avoid taking in at Mouth and Nostrils the offensive Exhalations; which, by invading the Seat of the Animal Spirits, and accompanying the Spirits to the Blood, disturb the economy of the natural Functions, and give rise to the above-mention'd Disorders."

No more graphic description of the worst form lead poisoning can take could be given than the description which Ramazzini quotes of an Anjou painter who

"was seized at first with a Shaking and Trembling in his Fingers and Hands, and afterwards with Convulsions in the same Parts, which likewise affected the whole Arm. Sometime after, the same Symptoms appeared in his Feet, and at last he was taken with such a grievous Pain in his Stomach and both the Hypochondria, that neither Glysters, Fomentations, Baths, nor any sort of Remedy gave him ease. The only relief he had in the violence of the Fits, was to have three or four Men, leaning with all their Weight upon his Belly, the Compression of which lessen'd the Torment. In this miserable Condition he continued for three years, and then dy'd Consumptive."

Of this case, too, he adds the true observation about the findings of post mortem in cases of acute plumbism, that "there was nothing preternatural to be seen about the Viscera"; and he commends the honesty of the narrator who frankly confessed "All of us mistook the Case, and were quite out of the Way."

House painters and coach painters are still to-day the greatest sufferers from lead poisoning. Seeing that locally applied exhaust ventilation is impracticable for their work, there can be only one way in which the poisoning can be stopped, and that is by the substitution of zinc oxide for lead paints.

I have spoken of Ramazzini's chattiness. Here is an anecdote he gives about Corregio:

"The same is the Cause of their discolour'd Complexions, and Cachectick Habit of Body; as well as of the Melancholick Fits they are usually Subject to. 'Tis said of Antonius de Allegris, commonly called Cro Corrigiensis from Corregio the Place of his Nativity, that he was so melancholy and even stupid, that he had no Sense of the Value and Excellency either of himself or his Pieces; insomuch that he returned to his Admirers the rewards they sent him, as if they had been mistaken in giving a great Price for those Pictures which are now above any Price whatsoever."

Turning now to another great group of craftsmen of the Middle Ages, to whom we owe so much of the finer pleasure of life — the stone-hewers, stone-cutters, and statuaries — Ramazzini says "they oftentimes suck in, by inspiration, the sharp, rough and corner'd small Splinters or Particles that fly off; so that they are usually troubled with a cough, and some of 'em turn Asthmatick and Consumptive." And he goes on:

"And in dissecting the Corps of such Artificers, the Lungs have been found stuffed with little Stones. Diemerbroek gives a curious Relation of several Stone-cutters that dy'd Asthmatick, and were open'd by him; in whose Lungs he found such heaps of Sand, that in running the Knife thro' the Pulmonary Vesicles, he thought he was cutting some Sandy Body. He adds, that he was inform'd by a Master Stone-cutter, that in cutting Stones there rises such a subtile Dust, as is able to penetrate thro' Ox Bladders hung in the Shop, insomuch that in the space of one Year he found a handful of that Dust in the Cavity of the Bladder: And this very Dust he took to be the cause of the Death of many unwary Workmen."

How interested Ramazzini would have been to know that not all stones make the lungs cut, as he puts it, "like some sandy body," but only sandstones, gritstones, and the like, which contain large amounts of free silica or flinty matter, as my late colleague, Dr. Collis, has recently shown. And would he not have been interested to know that last year (1918), in the gold mines of the Transvaal, hundreds of thousands of pounds were given out in compensation for this condition of "flint on the lung," and that its detection occupied the whole time of six physicians?

Those who grind plaster in hand-mills and sift it, and manipulate the fine plaster into "various Pieces especially Images and Effigies for the Adorning of Churches, great Halls and Libraries," he has frequently observed "usually labour under a difficulty of Breathing . . . and their Faces are discolour'd and truly pargeted."

Here, and in all his references to respirators, Ramazzini is very sensible, for he recognizes that workmen cannot wear them for any length of time.

"Tho such Workmen have a Cover for their Mouth, they can't avoid receiving the flying particles of the Parget at Mouth and Nose; upon which these Particles enter the Passages of Respiration, and mixing with the Lymph, rise up in hard chalky

concretions, or by daubing the winding Passages of the Lungs intercept the Freedom of Breathing."

Again in discussing the preventive measures possible for bakers, he says:

"In the first place those who boult the Flower and cleanse it from the Bran, and are always shaking and turning the Sacks and Bags, cannot possibly so cover their face as to avoid the Inspiration of the flying particles of the Meal, together with the Air; and these being fermented with the Salivary Juice, stuff up not only the Throat, but the Stomach and the Lungs with a tough paste; by which means they become liable to Coughs, Shortness of Breath, Hoarsness, and at last to Asthmas; the wind Pipe and the Passages in the Lungs being lined with a Crust that interrupts the Intercourse of the Air. Further, the particles of the Flower or Meal that stick to the Eyes, pinch 'em very much, and oftentimes occasion a Blear'dness.

"I freely own, I can't think of any effectual Preservatory caution for these Workmen. I approve of the custom they have of tying a Linnen Swathe round their Face, but all that will not hinder the Atoms of the Flower to invade the Breast along with the Air."

And yet again, of the sifters of corn and grain:

"The Workmen employed in these services use to cover their Mouth and Nostrils with Handkerchiefs, to keep out the Dust, and to wash their Throat and Eyes often with cold Water; but all this Caution is not sufficient to indemnify them."

He describes industrial eczema, that bugbear of so many workers, who are exposed to dust and liquid. Bakers' hands, he says, are sometimes "swell'd and pain'd." "And indeed 'tis observable, that all of 'em have very large thick hands. . . . So that Bakers quickly discover their Trade, when they shew their Hands, for no Handicraftsmen have larger Hands than they."

And of washerwomen he says, "The sharpness of Lye exposes them to Chops in their Hands, which are sometimes so deep and troublesome, as to be followed with an Inflammation and a Feaver."

He refers also to the carrying of heavy weights as a cause of hernia among millers, from the bearing of sacks of corn or meal on their shoulders.

Where Ramazzini seems to get hold of the wrong end of the stick is in attributing all manner of diseases, "shortness of breath, headaches, megrims, and cachexies" to noisome smells and exhalations. In mediaeval times, what we speak of as offensive businesses — candle-making, gut-scraping, tanning, and the like — must have been carried on with little regard to the susceptibilities of the neighbourhood. Ramazzini confirms what we find stated in certain guild ordinances that offensive callings, like tanning, had to be exercised in the suburbs in places allotted to them. What these smells must have been like may be gathered from his description of the effect of the dressing of hides:

"I have oftentimes observ'd, that neither spurring nor whipping would make some Horses pass by such Places, but as soon as ever they smelt 'em, they turn'd about, and without any regard to the Bridle, run directly home, as if they had been mad. The Houses in which these Hides are dress'd, are plac'd either near the Walls of Cities, or without the Walls, as in this city of Modena, to prevent the infecting of the Air."

Ramazzini is quite wrong in attributing illness from their trades to those, such as the makers of catgut, who did certainly require welfare arrangements, such as washing accommodation, first aid, overalls, and mess room, but were not, as he says they were, "wan in the face, and cachectic." What can have been the composition of the tallow candles from which a certain John contracted "a grievous Disorder in his Lungs and his Brain," as he pursued his studies by their light? Still more surprising are the passages stating that lime wash (on walls) is the cause of acute fever and ill distemper, even six months after it has been applied. He must mistake cause and effect, for the condition which led to the need of the lime washing was no doubt the cause. With his belief, what would he have said to the requirement of the English Factory and Workshop Act that every room shall be lime-washed at least once every fourteen months?

This subject brings us to the suggestion made by Ramazzini in regard to welfare and preventive measures. As to hours, he expresses himself most interestingly on night baking, a subject which has come into prominence this year in England. Bakers are, he says:

"Exposed to infinite Fatigue and Toyl, and so brought under the lash of various Diseases. Bakers are generally at work in the night time, whilst others, having finished the Task of the Day are recruiting their Spirits with seasonable sleep; and then in the Day time they are shut up like Owls to take their rest."

He advises the washerwomen:

"As soon as their Work is over, to throw off their wet things, and put on dry Cloaths; in which point they are generally very careless: I advise 'em likewise to use Frictions; to turn away their Faces as much as they can from the Smoak of the hot Lye; to anoint their Hands with Oyntment of Roses or Butter; to abstain from gross Food; and to observe a regular Diet."

On the subject of baths he has some interesting observations which reflect on the gross manners of the times.

"In the Days of Antiquity, especially at Rome where there were so many Baths for publick Use, Workmen of sordid Trades receiv'd considerable Benefit by washing off the Impurities contracted in their way of Business, and retrieving their Strength, in Baths, as Baccius de Thermis well observes. But now-a-days those excellent Provisions are sunk, and so the City Tradesmen are depriv'd of a singular Benefit. To make up this Loss, when they go to Bed, let 'em endeavour to wipe off the foul Matter that hinders Perspiration, and correct the noysome smell that haunts 'em, by washing and rubbing their Bodies with a Sponge dip'd in hot Muscadine Wine: and by way of precaution, upon all holy Days, I would advise 'em to wash themselves at home in sweet water, and walk abroad in clean Linnen. For 'tis not to be imagin'd how much the Animal Spirits are Exhilarated by cloathing the Body with clean Things: and for that reason I can't decry enough that vulgar opinion which even some Physicians entertain, that sick people must not shift their Shirts or Sheets for Fear of becoming thereby weaker. . . . We conclude therefore, that we cannot too much recommend to Fullers and all others that live by Sordid, Slovenly Trades, the frequent shifting of their Linnen, and keeping their Body clean; that by that means they may prevent, as far as it's possible, the Diseases that flow from Filth and Nastiness."

And again, in recommending baths in the dusty work of corn sifting, he feels regretfully that his advice must fall on deaf ears.

"Questionless it would be convenient for 'em to use Baths, to wash off the dusty Filth that sticks in the Skin along with the Sweat; but now that Baths are in disuse, the poor Workmen are depriv'd of that Benefit: For we must not think that these Ancient Builders of Cities and Compilers of Laws, were at all that Charge and Magnificence of Building, not only in great Cities, but even in lesser Towns, in making publick Baths only to gratify the Luxury and Softness of Women and idle Fellows, but likewise for the sake of Tradesmen and hard Workers, that they might have an opportunity of washing off the Filth of their Bodies, and refreshing their weary Limbs at a small Charge. Upon this Consideration we have reason to curse those that brought so noble a Constitution into Dis-reputation; and by their open Iniquity in promiscuous Baths, provoked the Christian Piety to suppress them."

Of the textile industries—heckling, carding, spinning, and weaving of flax and hemp—the workers in which he describes as "daub'd over with Hemp Dust, pale Fac'd, subject to Coughs, Asthmatick and Bleerey'd," Ramazzini adds:

"The Winter being the Season allotted for that Work, they are obliged to work in close Places; and considering that the Hemp is very Greesy and Oyly, upon that occasion they cannot but take in at the Mouth these foul Particles that pollute the Spirits, and stuff up the Organs of Respiration. Add to all this, that the Hemp and Flax being steep'd in stagnating and putrid Water, and dawb'd over with Clay to promote its readier maceration under the Water, the Particles thus imbibed cannot but be virulent and open enemies to human Nature."

Ramazzini notes the same fact that I have myself found that:

"These work-People complain that they suffer more in Hatcheling of Flax than in Hemp: and that, perhaps, because the Powder or Dust of the former is subtiler, and so making a smarter irruption into the Organs of Respiration, provokes 'em more sensibly to throw off the clog that galls 'em."

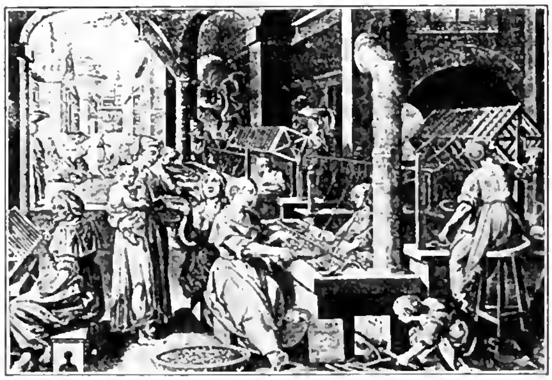

FIG. 3. — Winding silk from cocoons. (*Seventeenth Century. From "Guilds of Florence" by Edgcombe Staley.*)

And I remember, twenty years ago, in an inquiry into the health of silk spinners, having occasion to bear witness to the accurate description he gives of the unpleasant nature of the dust inhaled in the early processes of silk spinning:

"But worst of all is the Condition of those who comb the Silk Cakes that remain after the making of the Silk, in order to spin it into Thread for several Uses, as being less chargeable than the Silk it self. For when the Bags of the Silkworms, after being

steep'd in hot Water, are open'd and untangl'd by our Women, (that being the peculiar Province of the Women, as if Nature had provided Silk only for their Use) and wound upon Reels in small Threads, there are still some grosser Threads or Filaments behind, which have part of the Bodies of the Silkworms mixed with 'em; and of these they make a sort of Cakes, which they dry in the Sun, and give out to Workmen to have 'em drawn out into Threads with small Combs. Now the poor People that comb these Cakes are usually troubled with a vehement Cough, and a great Difficulty of Breathing, and few of 'em live to old Age in that way of Business. The Virulence that gives Rise to this Tragedy is owing to the cadaverous Particles of the Silkworms that are mix'd with the Cakes."

What could be a better motto for any manufacturer to lay to heart than the sentence with which Ramazzini closes this chapter: "'Tis a sordid Profit that's accompany'd with the Destruction of Health."

THE MORTALITY OF BITUMINOUS COAL MINERS FROM INFLUENZA-PNEUMONIA, OCTOBER TO DECEMBER, 1918*

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BITUMINOUS coal miners apparently suffered very severely from the influenza epidemic in the last quarter of 1918. Figures of mortality are available for a total of 4,700 miners insured in the Group Department of the Metropolitan Life Insurance Company during the period of the epidemic. The areas included a considerable number of mines in West Virginia and Pennsylvania.

In all, sixty-four deaths occurred among these coal miners from either influenza or pneumonia during the three months under investigation. This is equivalent to an annual death rate of 50 per 1,000. In other words, 5 per cent. of the miners would have died if the influenza epidemic had prevailed with the same severity over the entire year as in the last quarter. Among all occupied males, aged 15 years and over, the rate from influenza-pneumonia in the same three months was 22 per 1,000 or less than half as high.

The above figures are for all ages. But, at the age period 25 to 45, the rate was 62 per 1,000 living and at 45 to 65 years, 44 deaths per 1,000. In every instance, these figures are higher than any found in the entire industrial experience of the company for white males at the corresponding ages. In fact, in the age period 45 to 65 years, the rate among bituminous coal miners is close to four times as high as among all occupied males.

Coal miners ordinarily suffer severely from the respiratory diseases. During the epidemic, there was no exception to the rule.

The following table presents the death rates by age period among bituminous coal miners in comparison with those for all occupied white males:

INFLUENZA-PNEUMONIA MORTALITY AMONG BITUMINOUS COAL MINERS

October to December, 1918, Compared with All Occupied White Males, Industrial Department, Metropolitan Life Insurance Company

Age Period	Annual Death Rate per 1000	
	Bituminous Coal Miners	All Industrial White Males
All Ages †	50.1	22.3
15–25	29.5	17.5
25–45	62.1	32.6
45–65	44.4	11.7

† Fifteen years and over.

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INFLUENZA IN THE EASTERN GROUP OF TELEPHONE COMPANIES, BELL SYSTEM, 1918 *

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INFLUENZA is endemic in certain parts of eastern Europe. In a recent address, Flexner fixes its habitat in the border region between Russia and Turkestan. "Similarly, there are excellent reasons for regarding the endemic home of influenza to be eastern Europe, and in particular the border region between Russia and Turkestan. Many recorded epidemics have been shown more or less clearly to emanate from that area, while the epidemics of recent history have been traced there with a high degree of conclusiveness."

The disease is not a new one, though given the name of Spanish influenza last year. The first authentic epidemic in modern times, according to Craig and Dublin, was in 1510. The most recent epidemic prior to the one of 1918 was in 1891, which followed closely upon the epidemic of 1890. The epidemic of last year had its origin in its endemic home above referred to, whence it swept eastward and westward along the lines of travel. It appeared early in Germany and then in Spain. From the latter country it travelled into France and was for that reason called Spanish influenza by the French. The epidemic next appeared in pandemic form in Great Britain, and then along the Atlantic Coast of the United States, from whence it swept westward to the Pacific. While the primary phase of the epidemic in the United States has been thought to have been the pandemic sweep of 1918, the opinion has recently been expressed that the primary phase was really during the spring of 1918 and that the big sweep of October was the secondary phase. The statistics of the Eastern Group of Telephone Companies of the Bell System uphold this view.

The bacteriology of influenza is still unsettled. Numerous studies made by the world's most competent bacteriologists have failed to prove that the bacillus of Pfeiffer is the exciting organism, though frequently associated with the disease.

Influenza swept over the territory served by the Eastern Group of Telephone Companies in the fall of 1918 in pandemic form. During the crest of the epidemic, the telephone service was severely embarrassed by reason of the large number of cases among the employees, whose ranks had already been depleted by the call to arms and to other war activities. The increase of illness among the general population also added a heavy burden to the work of the telephone companies because of the increased number of calls for physicians, nurses, and druggists, and the increased amount of general business transacted by telephone. These last factors are peculiar to the telephone industry because epidemics, which incapacitate the employees, at the same time increase the amount of service demanded by the public. To safeguard the health of the telephone employees during such epidemics is therefore of the greatest importance not only for their personal benefit, but in order that the companies may continue to give the public adequate service.

It was with a view to determining how best the medical departments could assist in accomplishing the desired result, that the present study of the influenza epidemic was undertaken. Inasmuch as the chief function of the medical departments is to prevent illness among employees of the companies — the treatment of illness when it occurs being left to their private physicians — symptomatology, pathology or treatment are not dealt with in this study.

Great difficulty was encountered in securing adequate statistics because at the present time there are no illness records of all employees of the companies. The only statistics available were those of employees who were eligible for benefit under the Employees' Benefit Fund plan.

This study has special significance, be-

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TABLE 1. — ESTIMATED NUMBER OF EMPLOYEES (BOTH SEXES) IN EACH AGE GROUP ELIGIBLE FOR BENEFITS UNDER EMPLOYEES' BENEFIT FUND PLAN, 1918

Company	Total	16 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 & over
New York Telephone Co.	19,999	1,094	6,550	7,383	3,582	1,033	306	51
Bell of Pennsylvania	8,769	92	3,043	3,392	1,577	477	156	32
Chesapeake and Potomac	4,449	165	1,329	1,683	817	320	118	17
Eastern Group	33,217	1,351	10,922	12,458	5,976	1,830	580	100

cause it deals not only with the mortality of influenza, but also with its morbidity in contradistinction to the surveys of health departments and insurance companies which ordinarily deal only with mortality.

As has been said, the only statistics available were those of employees who were eligible for benefit under the benefit fund plan. Consequently, a large group of employees — to wit, those who have been in the companies' employ for less than two years — were not included, nor were those cases of illness among employees eligible for benefits where the duration of illness was less than one week. This last factor would seem to lessen the value of the statistics submitted but, on second thought, it will be realized that, while some cases of influenza may have escaped, all those minor cases of colds which might have been diagnosed as influenza have been eliminated.

Personnel

The number of employees eligible for benefit under the plan in 1918 could not be accurately determined, but the statistical office of the American Telephone and Telegraph Company furnished estimates of the number of employees at each year of age, which were then combined into ten-year period groups between 25 and 65 years of age. Under 25 years the number of employees was divided into two groups, one consisting of those from 16 to 19 years, inclusive; the other, of those from 20 to 24 years, inclusive. All over 65 years of age were grouped in one class. It can be gleaned from Tables 1 and 2 that the employees of the telephone companies were, for the most part, at the ages that suffered most severely during the past epidemic of influenza and that the average age of the female employees was lower than that of the male employees.

Morbidity

Tables 3 and 4 contain the number of cases of illness caused by influenza, bronchitis and pneumonia among employees eligible for benefit under the plan during the year 1918. In Table 4 the cases have been separated by sex as well as by age, while in Table 3 they have been separated only by age and company.

The highest case rate was among the group 16 to 19 years, but the employees at these ages were few, and in one company the number of cases among them exceeded the number exposed, due to the fact that several persons were reported as ill twice in the same year from influenza or pneumonia. The next highest rate was encountered in the group between 20 and 24 years. From that period the rate gradually

TABLE 2. — ESTIMATED NUMBER OF EMPLOYEES ELIGIBLE FOR BENEFITS UNDER EMPLOYEES' BENEFIT FUND PLAN IN 1918, SEGREGATED BY SEX, AGE AND COMPANY

Company	16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over		Total	
	M.	F.	M.	F.	M.	F.	M	F.	M.	F.	M.	F.	M.	F.	M.	F.
New York Telephone Co.	145	949	643	5907	3726	3657	3017	565	882	151	268	38	48	3	8,729	11,270
Bell of Pennsylvania	27	65	288	2755	1599	1793	1186	391	366	111	106	50	24	8	3,596	5,173
Chesapeake and Potomac	25	140	227	1102	916	767	660	157	269	51	103	15	13	4	2,213	2,236
Total Eastern Group	197	1154	1158	9764	6241	6217	4863	1113	1517	313	477	103	85	15	14,538	18,679

diminished until the group 65 years and over was reached, when the rate rose slightly again, but the number of persons here exposed was too small to justify any conclusions being based upon this partic-

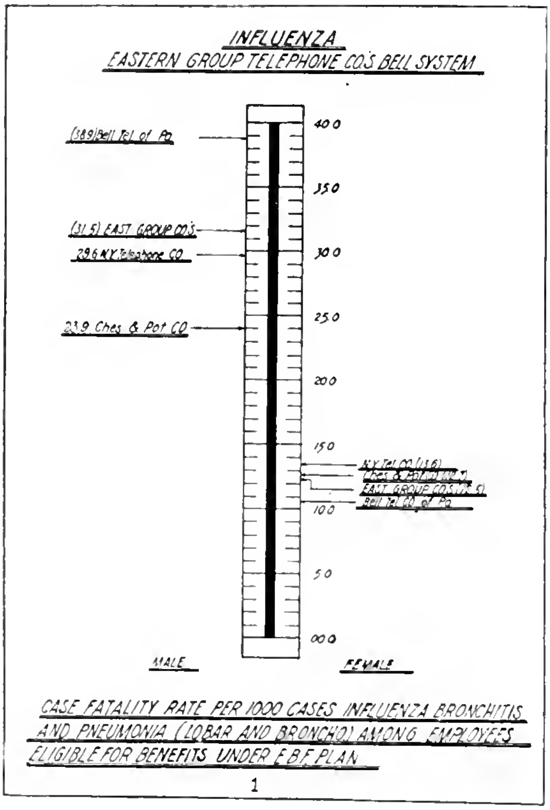

FIGURE 1.

ular rate. In Table 5 the rate of illness per 1000 employees in each age group is shown. While here again the data were not of sufficient volume to justify sweeping deductions being based on individual rates, certain general conclusions may be drawn from the statistics presented in this table when considered collectively. In every company the incidence of the epidemic was lower among the males than among the females, being 135 per 1000 against 254 per 1000 in the New York Company; 193 against 328 in the Bell of Pennsylvania; 170 against 245 in the Chesapeake and Potomac Telephone Company and 155 against 274 in the Eastern Group. Furthermore, this less favorable incidence among females is apparent at each age group up to and including the age group 45 to 54 years, inclusive. After that, there is a higher incidence among the males than among the females. This, however, may well be due to the paucity of data at the older ages, especially among the female employees.

FATALITY

Proportion of Deaths to Cases

In general, it may be said that the incidence of the epidemic was greater among the female employees than among the male employees, but on the other hand the fatality of the epidemic was greater *pro rata* among the males than among the females. For the Eastern Group, the case fatality was 31.5 for the males as compared with 12.5 for the females. (Table 12.) The number of cases and the number of deaths were so small that it hardly justified the computation of rates for each age group of males and females; however, the consistently higher case fatality rate of males as compared with females warrants the conclusion that, while there were fewer cases among the males, their fatality was far in excess of the females. Craig and Dublin in their analysis of the mortality among the policy holders of the Metropolitan Life Insurance Company encountered and called attention to the higher mortality among the males than among the females. The statistics of the Eastern Group of

TABLE 3.—NUMBER OF CASES OF INFLUENZA, BRONCHITIS AND PNEUMONIA (LOBAR AND BRONCHO) DURING 1918 AND RATES PER 1000 ELIGIBLE EMPLOYEES IN EACH AGE PERIOD

Company	16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over		Total	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
New York Telephone Co.	421	385	1622	247	1433	194	430	116	107	103	25	82	9	176	4047	202
Bell of Pennsylvania	77	830	1088	357	899	265	240	152	64	134	20	128	4	125	2392	273
Chesapeake and Potomac	57	345	312	235	351	208	143	175	41	128	17	144	2	117	925	208
Eastern Group	555	411	3022	277	2683	215	813	136	214	117	62	107	15	150	7364	222

Telephone Companies would indicate that this higher mortality among the males than among the females was not due to a higher morbidity among the males as compared with the females, but to a higher case fatality. This was probably due to the fact that the initial symptoms of influenza are often slight, with the result that robust persons are apt to disregard them and not take to bed. It was, however, among these neglected cases that the worst complications were encountered, so that it may be concluded that the men who did not promptly recover from their early symptoms, when compelled to report sick, had a poorer chance of recovery than did those who took the disease in hand early. This point will be dwelt upon in the recommendations.

It is interesting to note that the highest illness rate of influenza and associated causes was among the employees of the Bell Telephone Company of Pennsylvania. The illness rate for this company was 273 per 1000 employees as compared with 202 per 1000 employees of the New York Telephone Company, and 208 per 1000 of the Chesapeake and Potomac employees. These rates correspond to the observation of the health authorities in the districts covered by these companies, Philadelphia having a higher rate than either New York or Baltimore. The incidence rate for the entire Eastern Group was 222 per 1000 employees eligible for benefits under the plan.

Seasonal Occurrences

In Table 6 the number of cases of influenza have been arranged according to month of onset and confirm the very interesting fact that the first phase of the epidemic occurred in March and that the pandemic of October was really the second phase. In every company of the Eastern Group, the number of cases rose above the normal incidence in March, thereafter declining steadily until August. In September the incidence curve began to rise again, and in October reached its maximum when almost 4000 cases were reported in the Eastern Group among employees eligible for benefits. More than 2100 occurred in the New York Company, more than 1200 in the Bell Telephone Company of Penn-

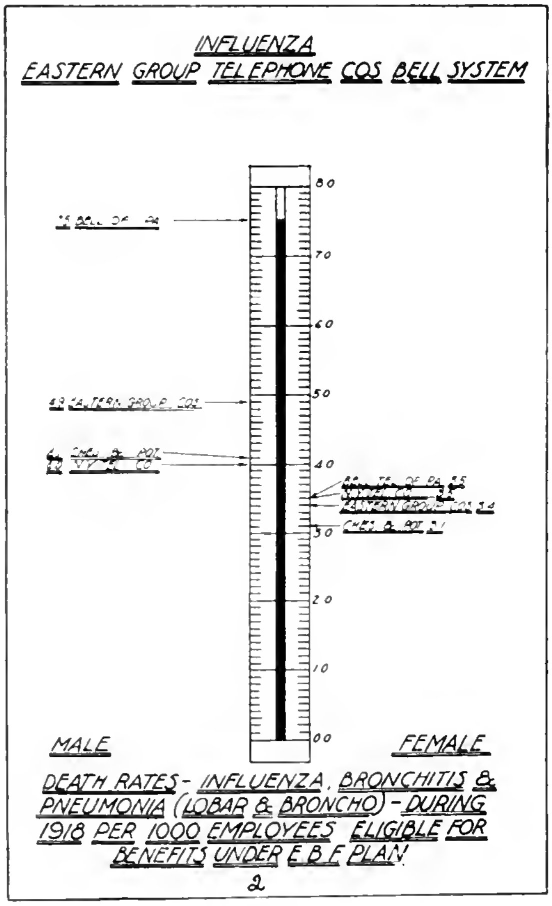

Figure 2.

TABLE 4.—NUMBER OF CASES OF ILLNESS CAUSED BY INFLUENZA, BRONCHITIS, PNEUMONIA (LOBAR AND BRONCHO) AMONG EMPLOYEES ELIGIBLE FOR BENEFIT UNDER EMPLOYEES' BENEFIT FUND PLAN DURING YEAR 1918

Company	16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over		Total	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
New York Telephone Co.	27	394	87	1535	589	844	356	74	90	17	23	2	9	0	1181	2866
Bell of Pennsylvania	6	71	65	1023	379	520	178	62	45	19	17	3	4	0	694	1698
Chesapeake and Potomac	6	51	29	283	169	182	114	29	39	4	17	0	2	0	376	549
Total Eastern Group	39	516	181	2841	1137	1546	648	165	174	40	57	5	15	0	2251	5113

TABLE 5.—RATES OF ILLNESS CAUSED BY INFLUENZA, BRONCHITIS AND PNEUMONIA, DURING 1918 PER 1000 EMPLOYEES ELIGIBLE FOR BENEFITS UNDER THE EMPLOYEES' BENEFIT FUND PLAN

Company	16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over		Total	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
New York Telephone Co.	186	415	135	260	158	231	118	131	102	112	86	53	187	0	135	254
Bell of Pennsylvania	222	1092	225	371	237	290	150	158	123	171	160	60	166	0	193	328
Chesapeake and Potomac	240	364	127	251	184	237	173	184	145	78	165	0	154	0	170	245
Eastern Group	198	447	156	291	182	248	133	148	115	128	119	49	176	0	155	274

sylvania and almost 500 in the Chesapeake and Potomac Telephone Company. In November the number of cases fell, to rise

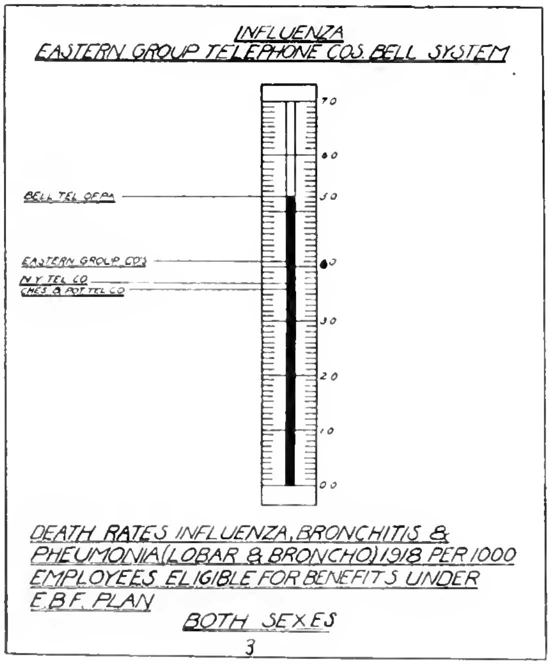

FIGURE 3

again slightly in December. No statistics for the early months of 1919 are available at this time. A monthly case rate, computed upon the data contained in Table 6, confirms the rise above normal in March, the decline until September and the tremendous increase in October, a temporary decline in November and a final rise in December.

During the first phase of the epidemic in March, the New York Company suffered more severely than the Bell Telephone Company of Pennsylvania or the Chesapeake and Potomac Telephone Company. In April, however, this was compensated for by the New York Telephone Company having the lowest rate of the three companies. In October, during the second phase of the epidemic, the highest rate of illness was experienced in the Bell Telephone Company of Pennsylvania, the rate being 141 per 1000 against 106 in the New York Telephone Company and 104 in the Chesapeake and Potomac Telephone Company, the rate for all three companies being 115 per 1000.

MORTALITY

Proportion of Deaths to Personnel

Considering both sexes together, the mortality rate of influenza was heavier among the group 25 to 34 years than among any other, whereas the morbidity rate was higher for the group 16 to 19 years; the next highest mortality rate was observed

TABLE 6. NUMBER OF CASES OF ILLNESS CAUSED BY INFLUENZA, BRONCHITIS AND PNEUMONIA (LOBAR AND BRONCHO) DURING 1918, SEGREGATED BY MONTH OF ONSET AND COMPANY

Company	Jan	Feb.	March	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
New York Telephone Co	213	156	367	153	38	24	26	28	244	2119	322	355
Bell of Pennsylvania	78	75	107	105	13	16	16	12	262	1240	131	227
Chesapeake and Potomac	61	38	47	36	11	4	4	3	69	464	77	111
Eastern Group	352	269	521	294	62	44	46	43	575	3823	530	693

TABLE 7. — MONTHLY ILLNESS RATES FOR INFLUENZA, BRONCHITIS AND PNEUMONIA (LOBAR AND BRONCHO), 1918[1]

Company	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
New York Telephone Co.	10.6	7.8	18.4	7.6	1.9	1.2	1.3	1.4	12.2	106.0	16.1	17.8
Bell of Pennsylvania	8.9	8.5	12.2	12.0	1.5	1.8	1.8	1.4	29.9	141.4	14.9	25.9
Chesapeake and Potomac	13.7	8.5	10.6	8.1	2.5	0.9	0.9	0.7	15.5	104.3	17.3	24.9
Eastern Group	10.6	8.1	15.7	8.8	1.9	1.3	1.4	1.3	17.3	115.1	15.9	20.9

[1] These rates have been computed on the actual number of cases reported during each month and the average number of employees eligible for benefits during the year — and not upon the number of cases multiplied by the fraction required to raise each month's cases to a yearly basis — for the obvious reason that the number of cases in October, if so multiplied, would exceed the population upon which the rate was based.

in the group 16 to 19 years; then followed the groups 55 to 64 years, 20 to 24 years, 35 to 44 years, and 45 to 54 years, in the order named. If the mortality rate for each sex is now examined separately, the highest rate for males is found in the group 16 to 19 years and the highest female rate in the group 55 to 64 years, but since in both these groups the deaths and exposures were few, it might be better to disregard them, so that when the sexes are considered separately as well as together the highest rates are encountered in the groups 25 to 34 years. The phenomenon of a higher rate among young adults was noted by all observers during the 1918 epidemic and is of interest because in the epidemics of 1890 and 1891 the highest mortality was observed among the very young and the very old.

Mortality of Eastern Group Companies Versus Mortality of New York City

If the mortality rates of New York City from influenza and pneumonia (lobar and broncho) are compared with those of the Eastern Group of Companies, it is found that in the city of New York the mortality for the group 20 to 24 years was 5.73 per 1000 persons at these ages, whereas, among the employees of the Eastern Group at similar ages, the rate was 3.1; and that the rate for the city of New York between the ages 25 and 34 years was 9.07 per 1000, whereas, among the employees of the Eastern Group, the rate was 6 per 1000. Between 35 and 44 years, the rate for the city of New York was 5.01 per 1000, whereas the rate for the companies of the Eastern Group was 2.8. At the other ages, the companies' rates are more favorable, but as the figures upon which they are based were small, further comparisons were not felt to be justified.

The mortality rates of influenza, bronchitis and pneumonia (both forms) for the

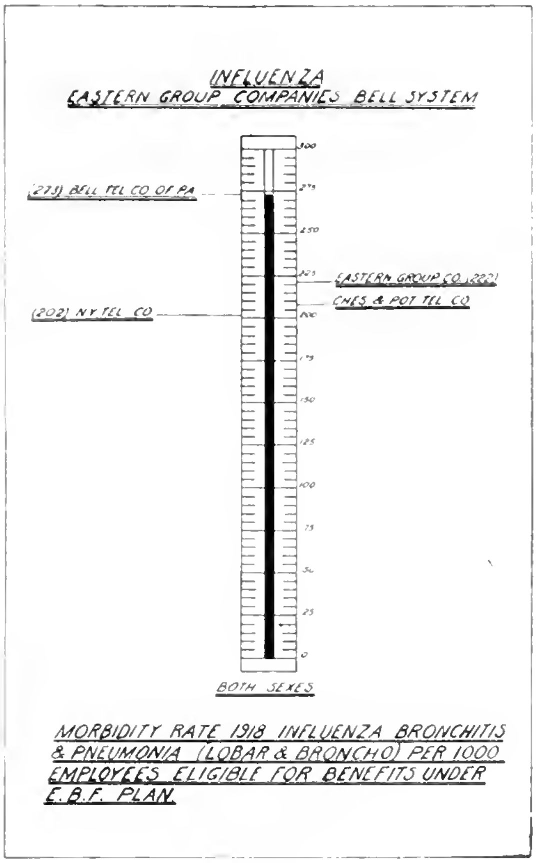

Figure 4.

New York Telephone Company compare with those for the city of New York as follows:

Ages	New York City	New York Tel Co.
20 to 24 years	5.73	3.2
25 to 34 years	9.07	5.5
35 to 44 years	5.01	1.7

These figures indicate that the mortality rate from the above diseases among the employees of the Eastern Group was considerably lower than among the general population, and since there is a definite ratio between deaths and illness, it is reasonable to assume that the morbidity from influenza was also less in the Eastern Group. Inasmuch as all observers are agreed that there is a direct relationship between economic conditions and the morbidity and mortality of influenza, the more favorable morbidity and mortality among the employees of the telephone companies may be attributed to their more satisfactory economic conditions.

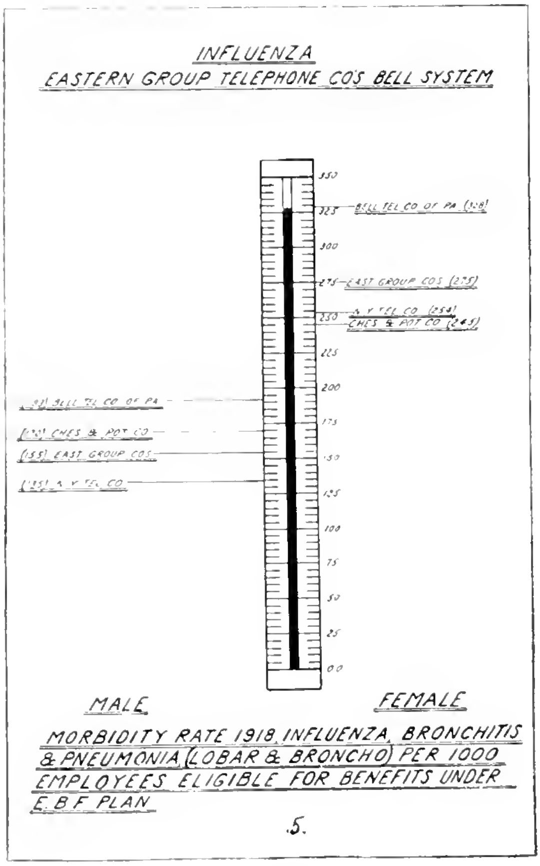

Figure 5.

Mortality Rates of the Different Companies

The mortality rates of the several companies of the Eastern Group show rather marked difference. The lowest rate was experienced among the Chesapeake and Potomac Telephone Company employees — viz., 3.6 per 1000 employees eligible for benefits. The next lowest rate was observed in the New York Telephone Company — to wit, 3.7 The highest rate was recorded against the Bell Telephone Company of Pennsylvania. These differences in mortality rate cannot be attributed to any differences in the environment of the employees of the several companies but to differences in the local manifestations of the epidemic. This opinion is upheld by the public reports which show that Philadelphia suffered a much higher death rate than did New York or Baltimore.

Case Fatality by Ages and Sex

As has been said elsewhere, the case fatality was higher among the males than among the females for the entire Eastern Group. The case fatality for males was 31.5 per 1000 and for females 12.5 per 1000. This difference in case fatality of the males as compared with the females is observed at every age period save the one from 55 to 64 years, where the male rate was 17.5 and the female rate 200, but this is due to the fact that in the New York Company there were but two cases of influenza among the female employees between 55 and 64 years and one of these died, giving

TABLE 8.—DEATHS CAUSED BY INFLUENZA, BRONCHITIS AND PNEUMONIA (LOBAR AND BRONCHO), SEGREGATED BY MONTHS, 1918[1]

Company	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
New York Telephone Co	1	0	1	1	2	0	1	0	1	57	5	5
Bell of Pennsylvania	0	0	0	4	0	0	0	0	4	23	6	8
Chesapeake and Potomac	0	0	0	0	0	0	0	0	2	12	1	1
Eastern Group	1	0	1	5	2	0	0	0	7	92	12	14

[1] Deaths too few to justify computing of monthly death rate.

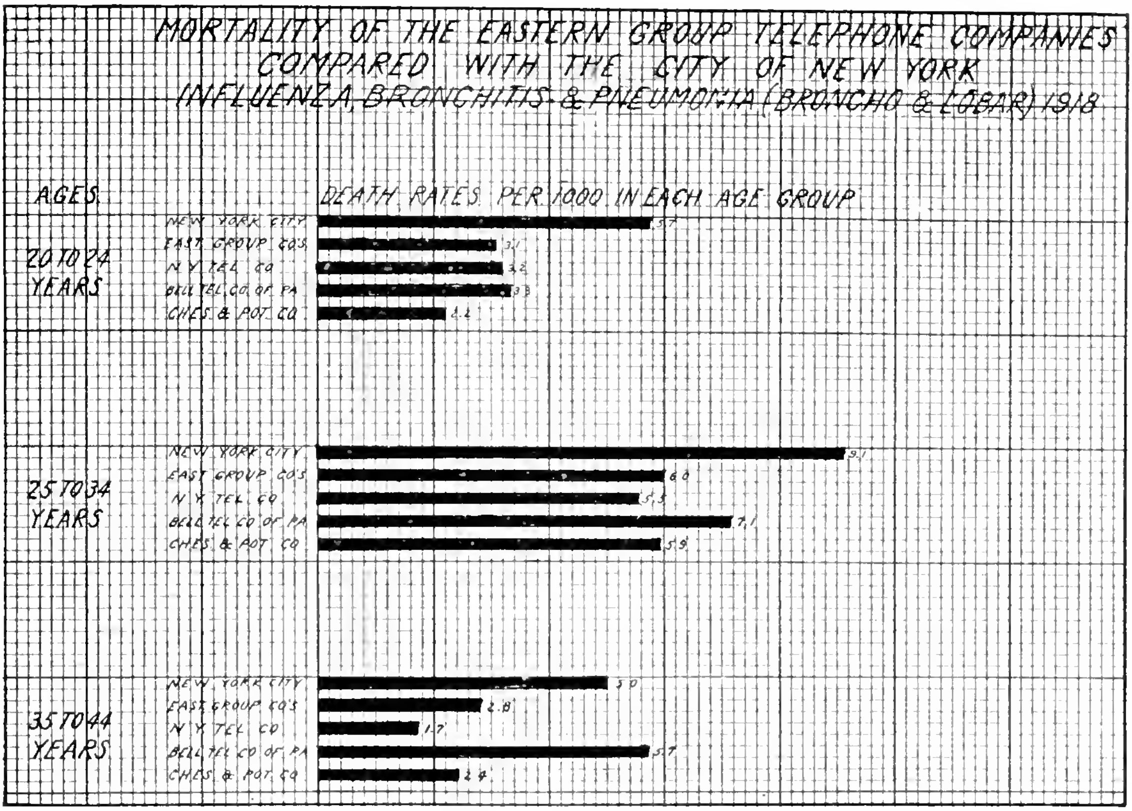

FIG. 6.—Mortality from influenza, bronchitis and pneumonia (broncho and lobar) in the Eastern Group Telephone Companies compared with the city of New York, 1918.

a 50 per cent. fatality rate. Among the female employees of the other companies, between the ages 55 and 64 years, there were no fatalities, which reduced the case fatality of the three companies, considered as a whole, to 20 per cent. But the figures here are so small, that a fatality rate based upon them must be disregarded. The case fatality rates of the different companies displayed rather wide variations, the male fatality rate being 24 for the Chesapeake and Potomac Telephone Company, 30 for the New York Telephone Company and 39 for the Bell Telephone Company of Pennsylvania, while the female fatality rate was 11 for the Bell Telephone Company of Pennsylvania, 13 for the Chesapeake and Potomac Telephone Company and 14 for the New York Telephone Company. These variations in the case fatality rates of the different companies, like the differences in mortality rates, must be attributed to local manifestations of the epidemic, though a small part of them may

TABLE 9.—DEATHS CAUSED BY INFLUENZA, BRONCHITIS AND PNEUMONIA AMONG EMPLOYEES ELIGIBLE FOR BENEFIT UNDER THE EMPLOYEES' BENEFIT FUND PLAN, SEGREGATED BY SEX AND AGE, 1918

Company	16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over		Total	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
New York Telephone Co.	1	0	4	17	21	20	5	1	3	0	1	1	0	0	35	39
Bell of Pennsylvania	1	0	2	8	14	10	9	0	1	0	0	0	0	0	27	18
Chesapeake and Potomac	0	1	1	2	6	4	2	0	0	0	0	0	0	0	9	7
Eastern Group	2	1	7	27	41	34	16	1	4	0	1	1	0	0	71	64

have been due to slight differences in the age distribution of the employees which were not corrected by using 5 or 10-year age groupings.

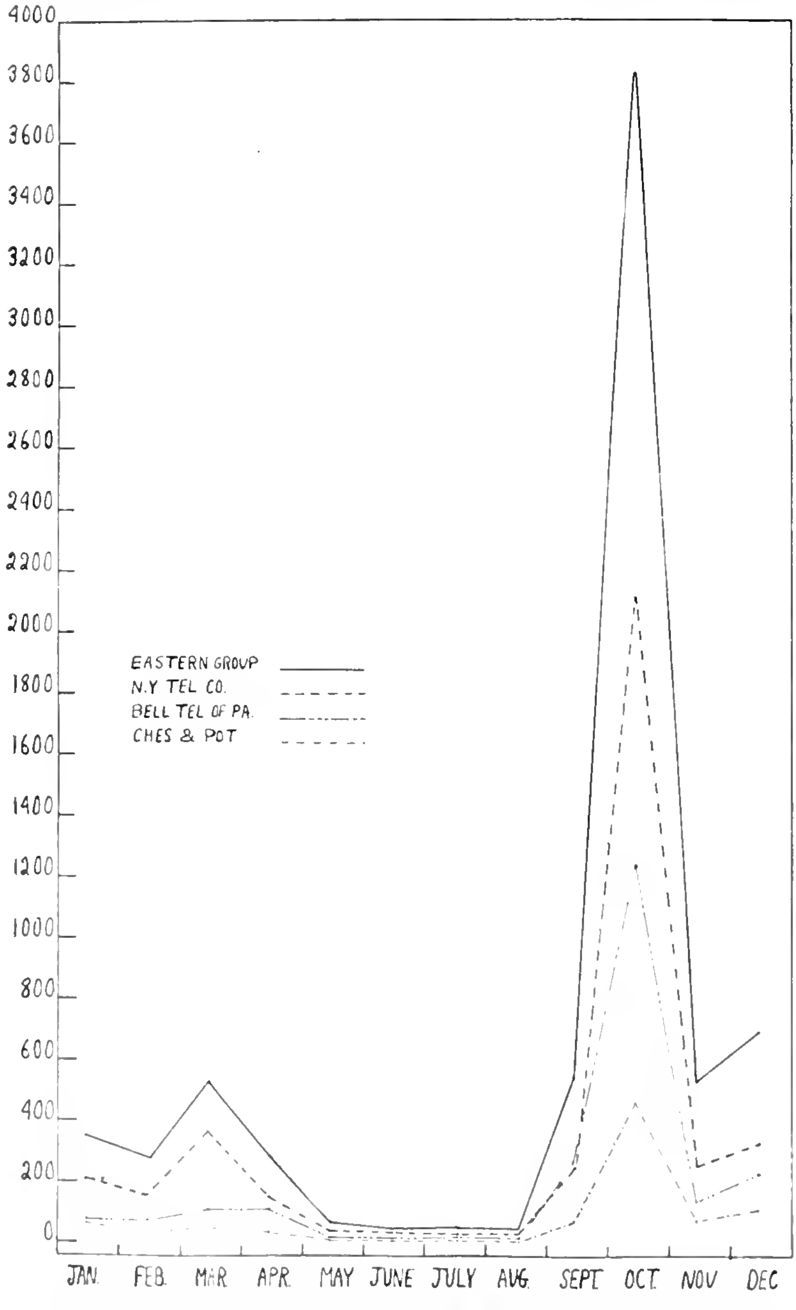

FIG. 7 Monthly number of cases of illness caused by influenza, bronchitis and pneumonia (lobar and broncho) during 1918.

Duration of Illness

The outstanding feature of Table 13, which deals with the duration of illness, is that the duration was shorter among the males than among the females. In other words, a larger percentage of the males recovered or died within eight to fourteen days, than did the females. This difference is manifested in all three companies. In the Eastern Group of Companies 39 per cent. of males recovered or died between eight and fourteen days, whereas 27 per cent. of females recovered or died during the first week of benefits; during the second benefit week the percentage of terminated cases among males and females was practically the same—viz., 23.2 against 23.3. In the third benefit week 15 per cent. of the female cases were terminated as against 12 per cent. of the male cases. During the fourth benefit week 9 per cent. of the female cases were terminated, as against 5 per cent. of the male cases. At the end of thirty-five days, 24 per cent. of the female cases remained unterminated, as against 20 per cent. of the male. The same differences are seen in the duration of the fatal cases among the male employees of the Eastern Group; 60 per cent. of the male cases terminated under eight days, as against 38 per cent. of the female fatal cases. During the second week 33 per cent. of the fatal male cases were terminated by death, as against 46 per cent. for the female. Between fifteen and twenty-one days, 4 per cent. of the male fatal cases terminated in death, as compared with 11 per cent. among the female fatal cases. This would indicate that the disease was more protracted in the females than in the males.

Preventive Inoculation

Early in the epidemic many bacteriological laboratories produced vaccines for

TABLE 10. — DEATHS AND DEATH RATES PER 1000 EMPLOYEES ELIGIBLE FOR BENEFIT UNDER EMPLOYEES' BENEFIT FUND PLAN FROM INFLUENZA, BRONCHITIS AND PNEUMONIA (LOBAR AND BRONCHO), 1918

Company	Total		16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
New York Telephone Co.	74	3.7	1	1.0	21	3.2	41	5.5	6	1.7	3	2.9	2	6.5	0	0
Bell of Pennsylvania	45	5.3	1	1.1	10	3.3	24	7.1	9	5.7	1	2.1	0	..	0	..
Chesapeake and Potomac	16	3.6	1	6.0	3	2.2	10	5.9	2	2.4	0	..	0	..	0	..
Eastern Group	135	4.1	3	2.2	34	3.1	75	6.0	17	2.8	4	2.2	2	3.4	0	..

TABLE 11. — DEATH RATE FROM INFLUENZA, BRONCHITIS AND PNEUMONIA PER 1000 EMPLOYEES ELIGIBLE FOR BENEFIT UNDER EMPLOYEES' BENEFIT FUND PLAN, SEGREGATED BY SEX, 1918[1]

Company	Total		16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Eastern Group	4.9	3.4	10.1	0.9	6.0	2.8	6.6	5.5	3.3	0.9	2.6	..	2.1	9.7	..	..

[1] The number of deaths and the number of exposures are too small to justify a computation of rates for age groups for the separate companies. The total death-rate figures for the separate companies are as follows: New York Telephone Co., M = 4, F = 3.5; Bell of Pennsylvania, M = 7.5, F = 3.5; Chesapeake and Potomac, M = 4.1, F = 3.1

TABLE 12. — CASE FATALITY RATE PER 1000 CASES OF INFLUENZA, BRONCHITIS AND PNEUMONIA AMONG EMPLOYEES ELIGIBLE FOR BENEFITS UNDER EMPLOYEES' BENEFIT FUND PLAN, 1918

Company	16 to 19		20 to 24		25 to 34		35 to 44		45 to 54		55 to 64		65 & over		Total All ages over 16	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
New York Telephone Co.	37	0	45.9	11	35.6	23.7	14	13.5	33.3	0	43.5	500	0	0	29.6	13.6
Bell of Pennsylvania	166.7	0	30.8	7.8	36.9	19.2	50.5	0	22.2	0	0	0	0	0	38.9	10.6
Chesapeake and Potomac	0	19.6	34.5	7.1	35.5	22	17.5	0	0	0	0	0	0	0	23.9	12.7
Eastern Group	51.3	1.9	38.7	9.5	36.0	22	24.7	6.1	23	0	17.5	200	0	0	31.5	12.5

TABLE 13. — DURATION OF ILLNESS CAUSED BY INFLUENZA, BRONCHITIS AND PNEUMONIA (LOBAR AND BRONCHO) BY SEX, 1918

Company		Total Cases of Influenza, Bronchitis and Pneumonia among Eligible Employees		Duration of Illness: 8 to 14 days 1st Benefit Week		15 to 21 days 2d Benefit Week		22 to 28 days 3d Benefit Week		29 to 35 days 4th Benefit Week		Over 35 Days	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
New York Telephone Co.	Male	1170	100	420	35.9	217	18.5	138	11.8	56	4.8	339	29.0
	Fem.	2847	100	676	23.7	604	21.2	407	14.3	281	9.9	879	30.9
Bell of Pennsylvania	Male	678	100	301	44.4	194	28.6	79	11.7	46	6.8	58	8.5
	Fem.	1685	100	564	33.5	432	25.6	271	16.1	144	8.5	274	16.2
Chesapeake and Potomac	Male	375	100	150	40.0	107	28.5	52	13.9	21	5.6	45	12.0
	Fem.	545	100	163	29.9	149	27.3	99	18.2	53	9.7	81	14.9
Eastern Group	Male	2223	100	817	39.2	515	23.2	269	12.1	133	5.5	442	19.9
	Fem.	5077	100	1403	27.6	1185	23.3	777	15.3	478	9.4	1234	24.3

the prevention of influenza. The Department of Health of the city of New York prepared and distributed a vaccine prepared from the bacillus of Pfeiffer. Most of those produced by other laboratories were mixed vaccines containing the bacillus of Pfeiffer, streptococci, staphylococci, and pneumococci. The medical departments of the telephone companies obtained a supply of the Health Department vaccine as soon as it was ready for distribution and offered free inoculation to employees, many of whom availed themselves of the opportunity. Had it been possible to have secured adequate controls, the statistics of the results of these inoculations would have been very valuable. Unfortunately the changing personnel of large corporations does not furnish conditions under which adequately controlled studies of the effectiveness of preventive inoculations can be made. For this reason it has not been possible to make a detailed analysis of the reports of these inoculations. Suffice it to say, that in not one instance among the great many employees vaccinated were any disagreeable symptoms or marked reactions encountered. In several offices where a representative number of employees availed themselves of inoculation, there seemed to have been a decidedly lower incidence of influenza among the inoculated than among the non-inoculated: in fact, the difference was so marked and the environment of the employees so similar that it would seem to indicate that the vaccination had exerted some influence in preventing infection among those inoculated. On the other hand, since the laboratory workers are far from agreement as to whether the bacillus of Pfeiffer is the exciting organism of influenza, there would seem to be little scientific reason for preventive inoculations with vaccines of this organism.

Notwithstanding the adverse testimony of the bacteriologist, some experts in public health work are of the opinion that preventive inoculations are of value. In view then, of the undetermined value of vaccines as preventives of influenza, the medical departments should not institute vaccination against influenza as a routine procedure but its harmlessness and possible value should be explained to interested employees and the operation performed for any of those who desire to avail themselves of its possible benefit.

Other Activities

During the epidemic of 1918, many precautions were taken in the companies of the Eastern Group to limit the spread of the disease, and all possible assistance and care was given employees. They were kept under close observation, and sent home and put under the care of their physicians at the first signs of a cold or cough. Generous leaves of absence with benefits were granted for convalescence. Arrangements were made for hospital care in a number of cases. In Washington, D.C., where there was a group of operators brought from other cities to help in carrying the enormous service load in that city during war time, an efficient hospital was organized on the shortest notice and a capable physician, assisted by a staff of nurses, gave all his time to the care of the employees. A rest home for convalescent cases was established in the outskirts of the city, with the best of results. Every local district officer of every division of each company did his or her share towards fighting the epidemic. And the extremely small number of deaths from influenza in the Eastern Group may fairly be ascribed to the loyal, patient teamwork of all concerned — from the humblest individual employee to the executive officers of the group.

General Conclusions

The prevention of influenza is not to be secured by any general or wholesale hygienic procedures, as in the case of typhoid fever by the purification of water supply and the pasteurization of milk supply, because the virus of influenza is transmitted by direct contact with infected persons, the germs of the disease being contained in the discharges from the respiratory passages of such persons.

Flexner has pointed out that the ideal method of combating this disease is its eradication from the localities where it is endemic and from which epidemics, or rather pandemics, spread. Such a method of attack, while logical, is not at the present time practical because of the expense involved and the low standard of national intelligence and lack of appreciation of public health on the part of the countries where the disease is dormant. It would, therefore, seem that this is a problem that must be solved by the concerted action of

the allied countries that suffer from visitations of this epidemic disease.

Since suppression at the source, as above described, is at present impractical, the next step that suggests itself is governmental quarantine; but here, because of the ready communicability of the disease and the present-day rapid methods of travel, control of epidemics of influenza by quarantine is very difficult if, indeed, not impossible. In New York City, Philadelphia and other large cities, the overcrowded condition of the transit lines adds to the difficulty of preventing the spread of the disease by infected persons. Therefore, in the final analysis, prevention is in the hands of the individual, and each must carry out his or her own preventive measures. Consequently, the function and the duty of the medical departments of the companies should be:

1. First to instruct employees as to the nature of this disease, the manner in which it is transmitted and the methods of prevention. Since the disease is spread only by infected persons coughing, sneezing, and expectorating, etc., without observing the proper precautions, and by the use of common drinking cups as well as the use of glasses, cups, dishes, and eating utensils that have not been thoroughly cleansed with boiling water, this end can be best accomplished through instruction and propaganda.

2. Should the epidemic of influenza recur to an extent which would warrant it, noonday talks should be given by the physicians and nurses of the medical department, and bulletins and news items issued in the official journals of the several companies.

3. These steps should be followed up by persistent efforts to detect cases of the disease in their incipiency among employees, in order that they may be at once sent home, primarily to protect their fellow employees from infection, and also that the sufferers may receive prompt and adequate medical care. The statistics of the Eastern Group, as well as those of other observers, conclusively show the importance of prompt and effective treatment. Supervisors, office managers, etc., should be instructed to be on the lookout for employees suffering from colds in the head, sore throats and similar conditions, and impressed with the necessity of referring such cases immediately to the medical department for examination.

4. Should the epidemic become severe, the nurses and physicians of the medical department should visit the various offices of the company each day for the purpose of making a rapid inspection of the employees in order to detect early cases.

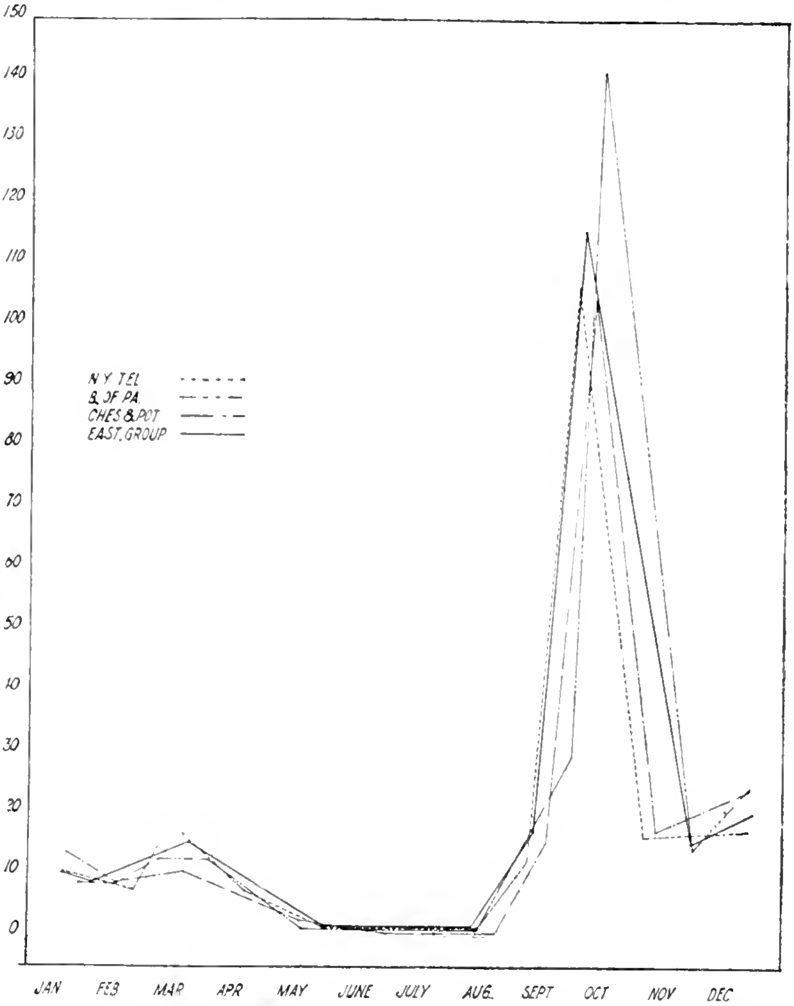

Fig. 8.—Monthly illness rates for influenza, bronchitis and pneumonia (lobar and broncho) during 1918.

5. Masking is of very doubtful value unless the mask is worn continually and is so constructed that it will thoroughly filter all the air breathed. Such a mask would be absolutely impractical for operators to use while on duty. Its practical value is questionable and its general adoption would tend to cause unnecessary hysteria. This was the attitude taken during October, 1918.

6. Gargling and spraying the nose and throat with various bactericides, such as argyrol and protargol, have some value. But in order to be effective, it must be done at very frequent intervals. Further, the procedure is apt to give a sense of false security which causes persons to be less mindful of the more practical methods of prevention.

7. All employees who have been ill with influenza should, before returning to duty, visit the medical department in order to make sure they have completely recovered. The general experience during the epidemic of 1918 was that persons who returned to work too early came down with relapses which, if they did not result fatally, at least caused protracted illness with annoying sequelae. Such examination is also necessary to make sure that employees are no longer harboring the germs of the disease which they might transmit to their fellow employees.

8. Inasmuch as diseases of the cardiovascular, respiratory and nervous systems are frequent sequelae of influenza, all persons who were ill with this disease during the past epidemic should be informed of the advisability of being examined either by the medical department or by their private physicians, in order that any of these diseases, should they appear, may be promptly detected and treated.

9. Discussion of what is undoubtedly the most important preventive measure has been reserved for the last — that is, good health. Good health is the most effective preventive of all diseases. If we will but keep our bodies in a healthy condition by proper hygiene, right living, careful eating, sufficient sleep, ample exercise, and all the fresh air and pure water we can consume, nature will keep a standing army and navy of "antibodies" that will conquer any and all invaders.

TABLE 14. — DURATION OF FATAL CASES OF INFLUENZA, BRONCHITIS AND PNEUMONIA, BY SEX, 1918

Company	Sex	Total Deaths from Influenza		Duration of Illness									
				Under 8 Days		8 to 14 Days		15 to 21 Days		21 to 28 Days		Over 28 Days	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
New York Telephone Co.	Male	34	100	23	67.6	8	23.5	1	2.9	..	..	2	5.9
	Fem.	39	100	19	48.6	14	35.8	5	12.8	..	..	1	2.9
Bell of Pennsylvania	Male	27	100	11	40.7	15	55.5	1	3.7	..	..	..	..
	Fem.	18	100	3	16.6	12	66.6	1	5.5	1	5.5	1	5.5
Chesapeake and Potomac	Male	9	100	8	88.8	..	..	1	11.1	..	..	..	..
	Fem.	6	100	2	33.3	3	50.0	1	16.7	..	..	..	..
Eastern Group	Male	70	100	42	60.0	23	32.8	3	4.3	0	..	2	2.8
	Fem.	63	100	24	38.1	29	46.0	7	11.1	1	1.6	2	3.2

Summary

1. Influenza is a highly contagious epidemic disease.

2. Public health methods of prevention have little effect upon epidemics when once started.

3. Prevention at the present time rests almost entirely with the individual, and the best method of preventing infection is by the maintenance of good health and good hygiene at business and at home.

4. Preventive vaccination is of doubtful value.

5. The early detection of cases is of the greatest importance in order to prevent transmission of the disease to others and in order to secure immediate treatment for the patient, thereby insuring early and complete recovery.

6. Men suffer a greater fatality from influenza than women, probably because of their disposition to make light of the primary symptoms of the disease and to con-

tinue at work until they are overwhelmed by it, by which time their chances of recovery are poor. Hence, special attention should be given the disease among male employees.

7. All persons who have been ill with influenza should be examined before being permitted to resume work in order to make sure that they are no longer infectious, lest they transmit the disease to their fellow workers, and to make sure they have completely recovered so that they will not suffer relapses resulting in protracted illnesses.

8. Such persons should also be examined at intervals after they have been permitted to return to work, in order that the chronic diseases which frequently follow influenza may be promptly detected and properly treated.

NOTES UPON AN UNREPORTED CAUSE OF OCCUPATIONAL DERMATOSIS *

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WHEN one meets with a case of occupational dermatosis, it is difficult to be certain whether or not a similar example has been previously mentioned. It so frequently happens that observers record new forms, as they crop up, in out-of-the-way periodicals and pamphlets. The whole subject does not lend itself to an orderly or connected classification, and for that reason has never been systematically summarized. Single instances appear in literature under various headings, particular trades, industries, occupations, chemical and physical agents, etc. Books on dermatology, and even those which deal exclusively with occupational diseases, discuss the matter meagrely and incompletely. To make references more easy, descriptions less disjointed, and safeguards better known, the methodical writer should endeavour to outline each injurious stage in the process of manufacture and uses of a material, or agent, and at each point indicate the noxious agent at work.

Animal skins, with their appendages, undergo many and complicated processes to be made serviceable for ordinary trade purposes. We are familiar with a number of the skin troubles they bring. Glibert (1) reported a curious, slow, progressive erosion of the skin of the fingers of men who scrape the skins and hair of rabbits. We know well the classical pemphygoid eruptions, acute and fatal or chronic and uncertain, in the handlers and strippers of dead carcasses. The septic sores leading to widely spreading lymphatic toxaemia, and the bacillogenic diseases, such as anthrax, from infected blood and dried secretions have been fully described. Out of 542 persons engaged in dressing, dyeing, and manufacturing furs, Kober (2) finds, after a careful inquiry, that no less than 163 suffer from skin diseases. Some are due to the arsenious oxide used in the preservation of the pelts; others, to the dyestuffs such as "ursol" (paraphenylene diamine), most commonly used to produce a brown colouration in furs. This substance can bring out a rash on either the dyer or wearer. We have further the callous formations on the hands of the dressers, cutters and beaters of furs, the prominent "segs" on the thumbs of the whitener of leather, and the "splayed" hand of the dresser, constituting veritable trade-marks in these workers. Other well-known disabilities in these industries are the fissures on the hands of "plankers" from the action of mercurous nitrate. In the hat-making trade this salt is required to make cut-fur, felt or interlace. Lastly, we must mention the holes seen in tanners caused by chromic acid. These are well known in many countries, each of which gives them a slightly different pet name. In England the labourer calls them simply "birds' eyes"; the French worker says they resemble the eyes of a "young pigeon"; and the German labels them the "gold-finch" ulcer. Chrome ulcers may end in serious mutilations.

The particular object of these notes is to draw attention to a skin complaint which attacks certain employees engaged in the fellmongers' yard. This work precedes that of tanning. In the first stage of the leather trade fresh skins called pelts are cured, and the epidermis with its appendages removed. In the case of sheep and the smaller animals this is done in fellmongers' yards. The skins of cattle, horses, deer, pigs, etc., required to make other varieties of leather, are cured and unhaired at different establishments or in the annexes to tanyards. The treatment is very much the same in both.

In the fellmongers' yard, if the hair or wool is intended to remain on the pelt, this is steeped in brine. If the wool requires removing, the fleshy sides of fresh or salt-free sheepskins are laid against each other, having previously been liberally brushed over with a thick cream containing an excess of slaked lime and 5 per cent. sodium sulphide. They are then lifted into the floods or vats by men called jobbers or washers. After remaining there for a suf-

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ficient time, the pelts are carried to the washing pits by the curers.

Gloves are invariably worn for the first removal, particularly in the foreign pelt trade, where a very strong solution of sodium or calcium hydrosulphide is used as a quick unhairer.

In the second removal and also during inspection the hands are bare, and the beginner or careless worker suffers great discomfort owing to redness, tenderness and cracks which appear on the hands (3) from these chemicals. In these workmen as many as four to a dozen small ulcers, the size of a split pea, will be seen on the sides of the knuckles and on the interdigital skin of the fingers. The knuckles are swollen and inflamed.

The pelts are then conveyed to the unhairing room and placed, hair uppermost, on the pulling beam. The pullers scrape off the hair or wool by rubbing down the woolly skin with the balls of the naked thumbs and the ulnar edges of the palms of both hands. The characteristic rash and holes appear on these parts in the pullers. An expert puller will unwool 1000 sheep in a week.

The interaction of sodium sulphide with milk of lime produces calcium hydrosulphide and caustic soda. These cause the mischief in this particular trade. If neglected the ulcers penetrate deeply, the sores easily becoming infected, causing inability to work.

An effective trade-shop remedy is a drop of Stockholm tar applied to each hole. This appears to act as a protective, enabling the men to "carry on." Frequent washings of the hands in a weak solution of vinegar and water followed by the thorough rubbing in of an ointment are helpful preventatives. The ointment the writer prefers is as follows:

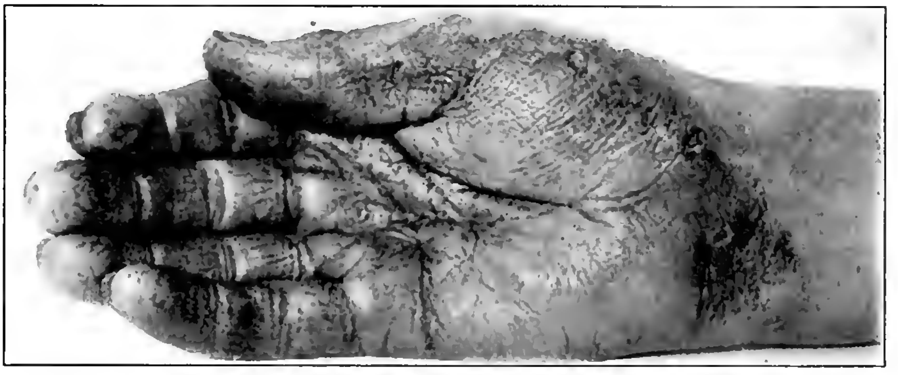

FIG. 1. — "Pullers'" rash from unhairing sheep's pelts. Note distribution and characteristic lime holes.

℞

Zinci oxidi	ʒ i
Acidi oleici	ʒ ix
Emplastri plumbi	ʒ x
Parenol	ʒ xxxviii
Hydrargyri ammoniati	ʒ vi

Misce.

Fiat unguentum.

This is a useful line of treatment in many trade processes where eruptions are liable to occur from the use of strong alkalies.

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PNEUMOKONIOSIS IN MAN AND HORSE *

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IN the ordinary conditions of living, the desirability of effective nose-breathing is rightly insisted upon by hygienists. In the unclean state of the atmosphere associated with many industries, the importance becomes much enhanced. It is well known that the vibrissae at the entrance of the nostrils impede and collect minute particles, micro-organisms, etc., floating in the inspired air. The part is well bathed by the exudations from the large and branching mucous glands, which further entangle any fine dust. Noxious germs are thus caught, and their activity lessened or destroyed by the cells of a healthy mucous membrane. Mucus is not a favourable culture medium and, in health, the surface of this membrane is usually sterile beyond the vibrissae. In normal weathers a strained, warmed and moistened air thus reaches the lungs.

In the habitual mouth-breather this important and constant safeguard is absent. The tonsils appear unable to perform their function, and if they or the pharynx are diseased (which they usually are in mouth-breathers), pyogenic bacteria are freely present. Air passes with greater force through the mouth, itself a hotbed for pus formation, so any air-borne cells and dust will more readily be carried into the bronchi. The nose and pharynx are not sterile when inflamed, and their normal deposit chambers are put out of action when obstruction is present.

This sieving property is well illustrated by the lesions inflicted at this part of the nose in workers in certain chemical powders. Dry chrome salt, some arsenical green colours, sheep-dip preparations, basic slag, the pollen of moulds and the fibres of certain vegetables are well-known causes of rhinitis, followed by ulceration of the nose at this particular point of the septum.

Dr. W. C. Rivers has elaborated the view that mouth-breathers are more liable to pneumokoniosis and possibly to tuberculosis than nose-breathers in an article on *Pneumokoniosis in Man and Horse* (Lancet, 1919, Vol. II, p. 55, and in previous papers). Comparing man with the horse when placed under similar conditions, he finds that the horse — a nose-breather entirely — never suffers from " miner's lung." He reports Haldane as saying that " the lungs of horses are less black than those of men." The article is both suggestive and interesting.

The habitual mouth-breather is thus deprived of one of the natural defences against the inhalation of objectionable industrial dusts. This loss is either congenital or acquired. Amongst the former are syphilitic or strumous deformity or defect of the nasal bones. Amongst the latter are adenoids, polypi, repeated colds and catarrhal states of the mucous membrane. The question is thus raised as to whether such sufferers should be excluded from working in dusty occupations? So far as the adult is concerned, there may be a doubt in any individual case, and the nature of the material worked with may be taken into consideration. On the other hand, it seems certainly imperative that children and young people affected by any of these disabilities should be excluded from such places as the mixing, card and spinning-rooms of cotton mills, or other dust-raising processes.

Rivers thinks that atrophic rhinitis should debar from work in such atmospheres, because this disease abolishes the filtering and other protective features of nasal breathing and allows the air to reach the lungs too readily.

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THE CONTROL OF INFECTIOUS DISEASES IN INDUSTRIAL COMMUNITIES*

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THE protection of a community against communicable disease is not a purely medical problem. Successful accomplishment is, indeed, based upon the facts of etiology and transmission. But the task of the sanitarian demands not only the judgment derived from experienced knowledge of scientific facts, but requires equally a close study of economic and social conditions and a sensible appreciation of the importance of educational propaganda and administrative organization.

The fundamental principles underlying the prevention of infectious diseases are, of course, the same whether we are dealing with industrial centers, military camps, schools or municipalities. There are, however, a great many details of practical management which must be adapted to the peculiarities of each particular community. Thus, the size of the group, the nature of its occupation, the average age of its members, and the environment in which its daily tasks are performed will materially affect the methods of approach and the thoroughness with which its problems can be met. The measures suitable for the protection of an isolated military unit of moderate size, upon the appearance of meningitis, should, in our opinion, differ fundamentally from those carried out in the face of a similar outbreak among divisional troops scattered over a combat area or on the march. This, again, would call for procedures distinctly different from those undertaken when the same disease appears among school children in a crowded city district, or again, among factory workers in a small industrial town. While it is possible, therefore, in laying down fundamental principles, to generalize concerning the sanitary management of any given disease, it is, at the same time, of great importance to develop the details with specific reference to the particular surroundings in which the disease appears. The necessity for such individual treatment of the problems of infectious disease has long been recognized in connection with school hygiene, and is rapidly forcing itself upon the attention of those interested in the development of industrial health control.

It is not, of course, possible entirely to separate school or factory control from the problems of general state health supervision. In the last analysis, protection against infectious disease is a state responsibility and the enforcement of preventive measures must be initiated by state and municipal health boards. But the task of the state will be rendered exceedingly difficult, perhaps even impossible, unless its resources are re-enforced by internal protective organizations provided within the various sub-communities such as those represented by schools and industrial units.

Whenever a group of individuals is brought together in daily association there is created a possible center for the transmission of infection. The members of these groups, exposed to the dangers of such occupational association, may carry disease to the homes to which they scatter when the day's tasks are done, and, conversely, they can pick up infection in their homes, in public conveyances and in places of amusement and carry it to the factory or office. The place of daily congregation, therefore, becomes a sort of clearing house for the distribution of infection. In consequence, there must be co-operation between the municipal or state authorities and those in charge of the industrial unit. The obligation of the internal organization is, of course, primarily to the workers themselves, protecting them against the dangers of infection during the performance of their duties. This is its first purpose not only for humane considerations, but in the interests of economic efficiency as well. Secondarily, such internal sanitary supervision will react favorably upon the health of the community as a whole, by individually controlling these potential foci of transmission.

To a considerable extent co-operation of this nature has already become an integral part of the organizations for health control

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in many industrial regions. Factory legislation, inspection by the state and regulations formulated by some labor unions have accomplished much in encouraging and, in some instances, in enforcing the establishment of sanitary conditions. The purely prophylactic phases of the problem are, in this way, being taken care of by the rapid development of interest in industrial hygiene. And the prophylactic problem is, of course, by far the more important phase of the subject, for, as Soper has correctly stated in a recent article, the epidemic diseases are being conquered not so much because of the direct measures taken against them individually, as because of the many indirect influences that are brought into the lists and which may be summarized as a "higher standard of living." Attention to proper ventilation, the avoidance of fatigue, washing facilities, sufficient and clean lavatories, maintenance of suitable temperature whenever possible, rest hours and the provision of cleanly restaurants and dining rooms, opportunities for exercise and recreation, drinking-water control, dust prevention and specific measures of protection against poison gases or bacterial infection in trades necessitating contact with such factors of injury—these constitute the important general sanitary measures which diminish the probabilities of infectious disease as far as the local conditions are concerned. The thorough development of such measures to the limits of possible enforcement will be the immediate care of those in charge of industrial health control. The importance of such general sanitary measures is, I believe, sufficiently recognized by health authorities and by employers. The principles underlying them are simple, easily explained to every sensible layman, and their practical application can be presented as a definite proposal to invest a certain amount of capital in an undertaking which is sure to yield a high percentage return, not only in terms of philanthropy, but in increased economic efficiency, actually calculable in terms of dollars and cents.

It is not with such matters of general sanitation that we will concern ourselves in the present paper. They constitute a separate chapter in the story of preventive measures, and are more or less thoroughly discussed in such works as Rosenau's *Preventive Medicine* (1), Price's *Modern Factory* (2), etc. Moreover, the experience of many men who have had practical contact with these problems is being gradually written into our state laws in the form of industrial sanitary regulations. Our purpose in this paper is rather to deal with the management of outbreaks of disease which may occur in spite of the protective walls of sanitary supervision, and to indicate the specific method of approach that we believe most suited to the suppression of each disease under conditions such as those likely to prevail in factories and industrial centers. These matters cannot be codified. They will vary with the discovery of new facts about the transmission of disease and they will be subject to change of details according to variations in the size, the organization, and the industrial purposes of the individual plants.

As indicated above, the arrest of an epidemic once well started is infinitely more difficult than the suppression of a focus at a time when a few cases only have occurred. It may almost be said that a system of prompt information of early cases is by far the most important factor for success. The most elaborate organization for hospital care, epidemiological investigation, sanitary construction, etc., is rendered useless unless there is a proper starting device for this machine in the form of an efficient system of information. Fortunately, it is not difficult to organize a system which can elastically be adapted to plants or communities of any size.

Let us assume that we are dealing with a plant where workers, when first being employed and periodically thereafter, are subjected to a physical examination — a thing which we assume is being carried out in most industrial communities in which this type of work is being done at all. It will be a simple matter to add to the record of each worker his infectious disease history. It is, of course, impossible to obtain accurate data of previous infectious diseases for more than a limited percentage of individuals, but reasonable accuracy can be attained for a relatively large percentage and, since a considerable number of these will have been treated in hospitals accessible by mail, all recent attacks of infectious disease can be definitely ascertained. The value of such records cannot be overestimated when measles or scarlet fever or other diseases in which one attack conveys a relative immunity occur in a plant. There should be added to such records, the date and success

of the last smallpox and typhoid vaccination, and whether or not the individual has had horse serum injected in the form of antitoxin, since this fact is becoming an increasingly important matter in connection with subsequent serum treatments. The record should show also the number in the family, age of children, whether they are attending school and where.

When the worker is once established as an employee, his or her place of residence can be marked on a spot map, and maps kept of the places in which the various workers live with their families. In cases in which the plant is sufficiently large to warrant the necessary personnel, periodical visits to the residences of workers and advice concerning ventilation, sleeping quarters, etc., will probably be increasingly well received as the purposes of this service become apparent. This will also serve in checking city inspections and the enforcement upon landlords of sanitary regulations. With this knowledge constantly available and kept up to date by periodical correction, a liaison can be established with the local municipal health officer. The health officer of the given industrial plant should receive the daily reports of communicable diseases which come to the health department of the town or locality. With colored pins or other simple means of marking, it is a relatively easy matter to keep a record of the mutual relationships of diseases that may occur at the plant and those which occur in the community at large.

It goes without saying that the health officer should be thoroughly familiar with such general public health arrangements as the municipal and local water and milk supplies and, if a laboratory is available, he should periodically have his own examinations made.

In the problems of individual medicine, the measures of relief and therapeutics are matters that primarily concern the attending physician and surgeon and his immediate staff. In this relation there is a certain therapeutic advantage in keeping the patient in ignorance of the plan and purposes of the measures adopted for his welfare. In contrast to this, in community medicine success or failure depends to the very greatest extent upon the co-operation of the entire group. Fortunately, the principles on which public health measures are based are, for the most part, exceedingly simple.

In carrying out an educational campaign for laymen it is neither necessary nor desirable to go into scientific details about the characteristics of individual communicable diseases except as a specific aid in meeting an existing emergency. It is best to speak in general terms and to classify the diseases, against which the community is to be protected, into groups as follows:

I. The *respiratory diseases*, conveyed by the mucus of the upper respiratory passages and acquired by entrance through these same passages.

II. The *intestinal diseases* transmitted by intestinal discharges and taken in by ingestion.

III. *Disease transmitted by* the intermediation of *insects*.

For each one of these groups a general scheme of safeguards may be outlined which will, to a considerable extent, convey the necessary information for all diseases included in each respective group.

By means of informal lectures or through circularized bulletins, analogous to those issued from the headquarters of armies as "Official Bulletins" or "Special Orders," such information can be passed on to the members of the community.

We will not attempt to formulate such communications in detail but will discuss each group of diseases in a general way, as a basis for general educational work, and will then take up individual conditions with more particular attention to technical matters.

I. RESPIRATORY DISEASES

General Considerations

When speaking of respiratory diseases from a sanitary point of view, we mean not only the diseases that manifest themselves in respiratory symptoms and pathological changes in the respiratory organs, but we include all other conditions in which the infectious agent or virus is distributed with the saliva and mucus and enters the new host through nose or mouth. We must include, therefore, in addition to the pneumonias, influenza, and various forms of bronchitis, such diseases as measles, scarlet fever, smallpox, and chickenpox, diphtheria, meningitis, and mumps. Were we dealing only with the protection of healthy individuals against patients suffering from such diseases, the problem would be comparatively simple, since early diagnosis, isolation of the sick, and care in delaying the discharge from hospital until the patients have ceased to be infectious would suffice to provide an adequate insulation about our

focus. Unfortunately, however, this is not the case. Many individuals are immune or highly resistant to micro-organisms which can cause disease in others, and we are, therefore, confronted with the so-called "carrier" problem which considerably complicates the difficulties of sanitation. This we will take up more particularly below.

It is perfectly natural that progress in preventing respiratory diseases has lagged considerably behind that attained in connection with those acquired by ingestion. It is far easier to control the things which people swallow as food than it is to supervise the innumerable possibilities of casual contact with the saliva of others, the spray sneezed or coughed into the atmosphere of closed spaces, or to control the universal habits of spitting and uncleanliness with nasal secretions.

There is, perhaps, no single factor which is more conducive to the spread of communicable respiratory disease than that of *crowding*. It is not feasible to give specific measurements of air space per individual for all cases since this must necessarily vary according to the nature of the work. Speaking generally, however, we should say that with proper ventilation there should never be less than 500 cubic feet for every individual employed, and that provisions for the removal of dust, incident to the work, must be provided.

The matters of *ventilation* and *sunlight* are of great importance, as is also the question of suitable temperature adapted to the degree of physical labor employed in the work.

Advice as to *clothing* is essential since it has been our experience that the laboring population, subjected often to insufficient heating in homes, is apt to dress too thickly in heavy woolen underwear, and consequently be subjected to sudden changes of temperature in going in and out while freely perspiring. It is desirable to arrange dressing rooms when workers are employed in heavy physical labor where, during the cold months, dry clothing can be put on before leaving work.

Whenever the workers eat at a common mess or restaurant the utmost attention should be paid to the proper *washing of dishes* (3) since in army experience there have been unmistakable indications that lack of proper cleansing has led to the transmission of respiratory infections. Actual boiling of dishes, while not always feasible in the army, should offer no difficulties under ordinary industrial conditions.

Spitting should be suppressed and spittoons, when provided, should be properly cared for so that they may not merely serve as filthy targets for many bad shots. In the American Army, particularly, spitting was a habit difficult to overcome and the fact that after all it is merely an unsanitary habit was shown by the fact that spitting was hardly a problem among the British and French.

Another matter of importance in the prevention of respiratory diseases is that of *wet instead of dry sweeping*. In most places that are properly supervised the vacuum cleaner has solved this difficulty, but where this is not in use the abundant sprinkling of floors while sweeping is an extremely important matter. Dry sweeping serves merely to redistribute bacteria and hurl them into the air; and there is increasing evidence to show that slow drying, as in dust, does not kill bacteria as rapidly as we had formerly believed. Stillman (4) has shown that virulent pneumococci can survive in dust, and a similar suggestion has been made in the case of poliomyelitis by Neustaedter and Thro (5). In the spread of dysentery, some British observers have assumed that distribution of living bacilli in dust has been of considerable importance, and our own epidemiological observations on two influenza epidemics in France have inclined us to believe that here, too, dust may have played a rôle in the transmission of the disease.

The mere supervision of these matters in the factory itself will not suffice, since the most dangerous exposure to respiratory infection may not necessarily occur during the working hours, but is much more apt to take place in sleeping quarters at night. In this respect the home of the worker can be reached only by advice and education as stated above, and it would seem to us a relatively simple matter, in industrial communities composed of intelligent workers, to establish a relationship of such mutual confidences with the working body that advice will be followed and that advisory visits to the homes will be permitted or even invited by the members of the group. It must be borne in mind that as far as respiratory infection is concerned the most concentrated and prolonged exposure occurs in sleeping quarters. If this factor were rigidly controlled, a very material diminution of this type of infection would occur. The astonishing influence of such control has been repeatedly observed in military sanitary work.

The Common Cold

In the general sanitation of respiratory diseases, it is our opinion that too little attention has been given to the so-called "common cold." This malady, though it probably causes a cumulative loss of efficiency in civilized populations greater than that caused by any of the other respiratory diseases, except perhaps tuberculosis, is the least well understood of these maladies. We do not know whether it is a single clinical entity or whether it represents mild attacks of a variety of catarrhal inflammations of the nose and pharynx. We do not know whether it is caused by a single or by a variety of infectious agents. Though streptococci, pneumococci, and various bacilli have been looked upon as the causative agents from time to time, none of these bacterial invaders have been definitely determined as specific factors. Recently Kruse (6), Foster (7), and others have suggested the possibility of a filtrable virus as

the infecting factor, a suggestion which is based on a number of positive experiments on human beings with filtered mucus. The supposition is indirectly borne out by the uniformly inconclusive results of purely bacteriological researches, by the absence of bacteria from the mucus of the early cases and by the extraordinary infectiousness of the condition. Our own observations of a few unpublished experiments by Hopkins in our laboratory would incline us to favor the possibility of a filtrable virus.

We cannot undertake in this place, however, to deal with the etiological problem in anything but a very cursory manner. Whatever the etiology may be, it is of the utmost importance that practical prophylaxis shall recognize the importance of serious attention to the common cold. This is necessary not only because the catarrhal inflammation of the nose, throat, and pharynx incident to this condition prepares a site for the lodgment and development of influenza bacilli, pneumococci, streptococci, diphtheria bacilli, and other organisms that may give rise to more serious disease, but also because the sneezing, coughing, and spitting of persons with colds result in the promiscuous distribution of micro-organisms lodged by chance in the upper respiratory passages of the subject. A carrier of virulent bacteria of the varieties mentioned may be relatively safe as an associate for others while he is in good health. When he begins to cough and sneeze he not only spreads abroad the virus that has given him a cold but, at the same time, spatters about a spray which may contain pneumococci, meningococci, etc. Not only may he directly infect susceptible contacts, but he will, at the same time, start a circuit of new carriers who, in their turn, will take up the distribution. The increase of carriers of all kinds during the wet and cold months is most probably dependent upon just this sequence of events. It has surprised us on a number of occasions (with the astonishment that comes to workers in this field whenever a theoretical deduction is confirmed by practical results) that the general sick rate of a troop unit can be reduced in a very short time when rigid attention is given to the prevention of simple colds.

The cold thus assumes a significance far greater than the mere propagation of other similar cases. In a group of fifty men or women there are more likely to be two or three that harbor meningococci, a similar number that may harbor virulent pneumococci, streptococci, or diphtheria bacilli. Let any of these begin to cough and sneeze, and other individuals, perhaps themselves immune, will begin to "carry" these bacteria, especially if at the same time they acquire the cold by which their naso-pharyngeal mucous membranes are converted into a particularly favorable nidus for the new invaders. During an epidemic of respiratory infections which we had occasion to study in 1907 (8) and during which a large number of pneumonias occurred, most of the men acquired severe colds. The conditions were such that by coughing, spitting, and sneezing a free distribution of organisms from man to man was to be expected. We examined twenty-five men from a company in which a number of pneumonia cases had occurred but who were perfectly well except for colds. Of these, 1 was a pneumococcus (type 1) carrier; 2 were pneumococcus (type 2, atypical) carriers; 1 was a pneumococcus (type 2) carrier; 2 were virulent streptococcus carriers; 1 was a streptococcus and influenza bacillus carrier.

More than one-fourth of this small group, therefore, had become carriers of organisms capable of causing respiratory diseases. Had we been in a position to extend this series, to examine also for meningococci and diphtheria bacilli, and to make a more systematic examination for influenza bacilli, the results might have been still more significant.

In the case of meningococci this fact has been noted several times, and Bassett-Smith (9), who examined some 27,000 men who entered the British Naval Service during the years 1916 and 1917, found the highest percentage of carriers in May, 1917, after an unusually cold April, and attributes this rise to the prevalence of catarrhs among the recruits during this time. We will have occasion to discuss these relations more extensively in the section on meningitis.

In the case of diphtheria, too, Moss (10) and others have noted increased carrier rate of diphtheria bacilli in school children during the wet and cold months, and we ourselves have seen a machine gun company with a diphtheria carrier rate of over 10 per cent. under conditions of crowding when catarrhal naso-pharyngitis was prevalent.

It is not difficult to demonstrate, there-

fore, the importance of preventing an epidemic of colds. It is not so easy to point out a method of achieving this result. The individual gravity of these cases is usually so slight that neither the physician nor the public can be persuaded to follow conscientiously directions which seem out of proportion to the seriousness of the immediate consequences. Ordinarily, the strongest ally of public health procedure is terror. It is a simple matter to enforce vaccination when a case of smallpox has appeared. The measures aimed at the prevention of any grave malady appeal to the public imagination. The often onerous details that, taken together, would reduce the incidence of colds, are more difficult to enforce. Nevertheless, the attempt should be made.

Were the writer in charge of any community unit in which severe colds were beginning to appear and isolated cases of true influenza were developing, he would immediately attempt to institute the following procedure, in addition to the general respiratory precautions already outlined.

Information should be conveyed to the workers either by conference or by a mimeographed circular, describing the infectiousness of the cold, its secondary dangers, and mode of conveyance.

The use of paper handkerchiefs and paper bags for soiled ones, placed near the worker's place, should be instituted.

Those actively sneezing and coughing should be excused from work or isolated in special parts of the room, and on these people temperatures should be taken. If a temperature of 100° or over were found, the patient should be hospitalized or excluded from common work rooms and mess whenever possible. If such individuals are sent home they should be warned against family contact. We believe that when persons with severe colds are living at home, local treatment such as periodical argyrol instillations are of some value in preventing distribution to others.

All the general protective measures concerning respiratory disease, as described above, should be rigidly enforced and supervised, and the necessary attempt should be made to persuade the workers to extend this system for the protection of their homes.

Influenza

As a clinical term, the conception of influenza has been much confused. In the past it has been applied to anything from a severe cold in the head to atypical bronchopneumonias. The study of epidemics, however, such as the pandemic of the nineties and the various outbreaks which have taken place during the war, has helped us somewhat in clinically defining this condition. We ourselves have had occasion to study a number of the early outbreaks of influenza which occurred in France among the American Expeditionary Forces, and from these observations, as well as from similar studies made upon the troops in the United States by Vaughan (11) and others (12), are convinced that this disease, in its pure form, need not primarily be associated with respiratory symptoms. Influenza, as it appears in the warm weather of early spring or late summer, at seasons when the general respiratory health of the community is apt to be good, shows no catarrhal manifestations of nose, throat, or lungs. The first group of cases seen by us in a military community at General Headquarters in France comprised over 300 cases. The disease assumed a form precisely similar to that which was described for some of the earlier epidemics in America. These cases were clinically very uniform, as follows: There was a sudden onset, the time of first symptoms often being determinable by the exact hour. Patients at a given time of the day or in the middle of the night would, without previous warning, suddenly be seized with a severe headache, pain in the back, limbs, chilliness, and, if the attack occurred in the daytime, vertigo and often nausea were noticed. Temperatures at this stage varied from 100° to 103°, but physical examinations were entirely negative. Except for occasional mild sore throats, these early cases showed no focus from which cultures were indicated. The leucocytes were depressed or normal, with usually a relative lymphocytosis. There were no enlargements of spleen or lymph nodes. The temperature would subside within three or four days, and no bronchial or pulmonary lesions developed. This was usually followed by an uneventful and rapid convalescence. Later, as the cold weather came on, similar outbreaks manifested more tendency to catarrhal respiratory symptoms. Sore throats were common, injection of the conjunctivae occurred, and mild bronchitis supervened. In these latter cases, influenza bacilli could often be

isolated from the throats. Later, in the cold weather, when men were exposed to crowding, to cold, and to wet weather, secondary infection of the respiratory organs followed and the simple character of the uncomplicated disease was completely obscured. The significance of such observations is that influenza, the pure and uncomplicated disease, is a systemic infection which is relatively mild and rarely, if ever, results fatally unless complicated by secondary infection. Of great sanitary importance, however, is the fact that such cases are excessively susceptible to secondary infection with pneumococci, streptococci and perhaps with meningococci. The secondary pneumonias which are so apt to follow may be caused by many different kinds of micro-organisms, the type of infection depending largely upon the bacteria which are most prevalent in the group. Thus, the pneumonias that accompanied influenza outbreaks sometimes showed a predominance of hemolytic streptococci or of the various types of pneumococci.

The etiology of the original influenza is a matter that is much in doubt. It is not possible at the present time to say with positiveness that the Pfeiffer bacillus is the cause of the disease, and it might well be that this organism is purely a secondary invader like the pneumococcus and streptococcus. However, as far as the studies that have recently been made can be summarized, the Pfeiffer bacillus must still be considered as the most likely cause of the infection. Claims have been made by the British that the disease is due to a filtrable virus, and extensive experimentation in this direction is in progress in a number of laboratories. In our own experience, cultures from throats of early cases that showed pharyngeal and bronchial inflammations have often yielded Pfeiffer bacilli, and this has been the experience of many other observers. The fact, too, that recent experiments by Parker (13) and by Huntoon and Hannum (14) have demonstrated the production of a toxin by this bacillus would explain the profound systemic manifestations that accompany a relatively mild local infection. For these and other reasons, we ourselves, at the present time, favor the view of the etiological responsibility of the Pfeiffer bacillus.

Mild in its uncomplicated form, the disease is a dangerous and fatal one in its consequences rather than in its inherent nature and, should suspicious cases appear in a group, the principal thing to remember is that they must be immediately hospitalized or at least put to bed under conditions of suitable isolation, such as those described for pneumonia. This has saved many lives by preventing secondary infection, and is one of the most important points insisted upon by clinicians like Harlow Brooks, Homer Swift, and others who have had extensive experience with epidemic forms of the disease.

The infectiousness of the disease is extreme. Epidemiological studies in France and elsewhere have shown definitely that, while the disease is easily transmitted from person to person, there are still other factors that lead to the sudden infection of a large number of people at about the same time. In the Chaumont epidemic, as well as in similar epidemics in the 42d Division studied by us, a large number of individuals in a given unit would come down suddenly within a very short time. In one company we remember that between sixty and seventy cases occurred within forty-eight hours. Such synchronous mass infection can be brought about by a limited number of factors only, either by ingestion of the infectious agent with food or by inhalation with dust. Investigations into food supply have proved uniformly negative, although there is a considerable possibility that some infections may be transmitted in dining halls and mess rooms through improperly cleansed eating utensils. It is also likely that a great many persons may be infected by dust, contaminated by the sputum of diseased individuals or carriers. On a number of occasions, the sudden appearance of many cases followed directly after troops had undertaken a long and dusty march.

The great infectiousness of the disease renders sanitary measures particularly difficult, and there is no reliable method of prevention that can be confidently recommended. The only measures that seem remotely hopeful consist in the rigid enforcement of the procedures outlined for respiratory infections in general and, in addition to this, insistence on careful inspection of the entire working personnel every morning. Individuals with headaches, pains in the back or legs, men who are suffering from obvious catarrhal infections of the mouth, nose, and throat, or who show conjunctival injection, should be

segregated and temperatures should be taken. All those with temperatures even slightly above normal should be put to bed under proper conditions for a few days. We believe that such measures could be successfully enforced in times of a general influenza epidemic. The general public is beginning to realize the seriousness of this disease when once it has gained headway, and education and insistence on rigid precautions even with the mildest cases will, we believe, be received with attention at such times. If early and mild cases could be promptly removed and segregated, a great deal might be accomplished in limiting the disease.

Measles

Not much need be said about measles since it is not a disease that is apt to assume epidemic dimensions in communities composed of the age-groups concerned in industrial occupations. However, this disease should not be completely neglected in our discussion since unusual circumstances might well bring about local outbreaks which, under conditions of faulty sanitation, could claim many victims. Like influenza, the disease is more to be feared for its secondary manifestations than for its dangers *per se*. In an epidemic which we studied at Camp Wheeler the mortality of measles pneumonias reached 29 per cent., whereas of the primary pneumonias 12.85 per cent. only died (8).

In protecting against the spread of measles, one particular procedure outweighs all other prophylactic measures. This consists in daily inspection of the entire group. A large number of persons can be efficiently scrutinized if directed to pass the inspecting officer in single file. A few questions are asked as to headache, appetite and sleep during the preceding night. Each individual is inspected for injection of the conjunctivae, redness of the throat, and for the presence of naso-pharyngeal catarrh. The skin of the chest and abdomen is rapidly looked at. Those that are in the slightest degree suspicious are asked to step aside until the inspection is over. On this group subsequent temperatures are taken. All those with temperatures over 99.5° are excused from work and placed under observation. The disease is most infectious during the very early stages before the rash has appeared, and by the time that a patient is sick enough to report of his own accord to the physician, the harm has been done.

The general measures as to cleanliness, etc., should, of course, also be observed. But we base our opinion on experience when we say that we believe that a measles epidemic can be arrested in its early stages if the daily or twice daily inspection is carried out skilfully and conscientiously.

Pneumonia

There are, of course, a large number of different forms of bacterial infection of the lungs which are classified together as pneumonia. In the following paragraphs we will confine ourselves to the discussion of pneumococcus infections, and since we are discussing industrial communities composed of healthy adults, we will deal primarily with the lobar forms of the disease. In the ordinary lives of peaceful communities, pneumonia rarely assumes epidemic dimensions. On occasion, however, it may become generalized; and of recent years it has been one of the most serious epidemic diseases that has occurred in army cantonments and camps. Indeed, wherever human beings live under conditions of crowding and exposure, especially during the cold and wet months of the year, the possibility of a pneumonia epidemic is created. Thus, there have been outbreaks recently in the mining districts of South Africa and in Panama, and there have been more serious ones in a number of our army camps. In the African and Panama epidemics, the disease attacked chiefly the negro workers. Outbreaks of pneumonia that assumed alarming epidemic proportions occurred in a very large number of both the barrack and the tent camps under conditions which have been carefully analyzed by Vaughan and Palmer (11), and it is stated by Soper (15) as accounting for 24,500 deaths, or 81.4 per cent. of all deaths in the army of the United States in 1918. The disease, therefore, presents definite epidemiologic possibilities. In times of peace, these will never be of such an appalling nature as they were in camps during the war, but we must always bear in mind the likelihood of smaller epidemic outbreaks in asylums, institutions, schools, labor camps and other industrial communities where a certain amount of crowding may often be unavoidable, and where

daily association of the same group of individuals is an occupational necessity.

The fact that pneumonia can be transmitted from person to person has long been suspected and Johannesen, years ago, separated by screens his pneumonia cases from other patients. This view, however, was an exceptional one until recent years, largely owing to the fact that pneumococci could be normally found in the mouths of many healthy individuals. Some years ago, we ourselves examined the mouths of several hundred healthy people and found pneumococci in something over 30 per cent. of those examined. Re-examined by the more perfect recent methods, these figures might probably be increased. In fact, the workers at the Rockefeller Institute * (16) have found pneumococci present in 116 out of 279 normal mouths examined. There was formerly a strong and, at that time, well-founded suspicion that many pneumonias might be the results of pulmonary auto-infection with the organisms normally present in the mouths of the patients. The entire field of pneumococcus investigation was, however, given a new direction when Neufeld and Haendel (17) discovered that by the use of highly potent sera produced with individual strains of pneumococcus, definite serological or antigenic groups could be differentiated. This observation was confirmed and very much extended by the workers at the Rockefeller Hospital whose classification of the pneumococci is now an established part of our knowledge of the group. This classification, as determined by agglutination reactions with specific sera, is shown in Table 1.

To make this chart entirely clear it is necessary to add that Type IV, unlike the others listed in the table, is not a homogeneous group, but represents a heterogeneous collection of pneumococci which do not agglutinate in the sera of the other types and have no fixed relationship to each other. Type IV is established merely as a matter of convenience, an attic into which all the heterogeneous groups can be stored until we can more definitely subdivide them. Many attempts have been made to subdivide Type IV into definitely recognizable sub-groups (18), but so far this has not been successful because investigation has always been forestalled by such extensive variation between the individual organisms obtained that no permanent classification could be adopted. The Type IV pneumococci are in the same condition as the so-called "streptococcus viridans" group, among which it is rather the exception to find serological homology between individual types. In addition to the types mentioned, there are undoubtedly other well-defined ones which future investigation will reveal. There are certain homogeneous groups found in South Africa and the Tropics that are as sharply homologous as Types I, II, and III, but which have not, up to the present time, been shown to occur in this country.

Though incomplete, this classification has already borne fruit in materially increasing our epidemiological knowledge of pneumonia. The workers at the Rockefeller Hospital, in analyzing the pneumonias occurring in New York City and vicinity, have found a distribution of types in lobar pneumonia as shown in Table 2.

Type determinations from mouths of normal persons, however, gave a different result, as shown in Table 3.

TABLE 1. — DETERMINATION OF PNEUMOCOCCUS TYPES BY AGGLUTINATION †

Pneumococcus Suspension, 0.5 c.c.	Serum I (1 : 20) 0.5 c.c.	Serum II (Undiluted) 0.5 c.c.	Serum II (1 : 20) 0.5 c.c.	Serum III (1 : 5) 0.5 c.c.
Type I	++	−	−	−
Type II	−	++	++	−
Sub-groups IIa, b, x	−	+	−	−
Type III	−	−	−	++
Type IV	−	−	−	−

Incubation for 1 hour at 37° C.

TABLE 2. — INCIDENCE OF TYPES OF PNEUMOCOCCUS IN LOBAR PNEUMONIA ‡

Type of Pneumococcus	Incidence	
	No. Cases	Per Cent
I	151	33.3
II	133	29.3
IIa	6	1.3
IIb	4	0.9
IIx	9	2.0
III	59	13.0
IV	92	20.3

* The pneumonia question has been thoroughly dealt with in a recent monograph of the Rockefeller Institute by Avery, Chickering, Cole, and Dochez, No. 7, Oct. 16, 1917.

† This table was taken from Avery, Chickering, Cole, and Dochez, loc. cit., p. 25.

‡ Loc. cit.

The striking feature of these tables is the fact that more than 50 per cent. of the organisms obtained from normal mouths belong to the heterogeneous group spoken of as Type IV, whereas the majority of lobar pneumonias (almost 80 per cent.) showed organisms of the more homogeneous types. It may be concluded from this work, therefore, that pneumonia is in most cases caused by organisms that are not present in normal mouths. If the tables are further analyzed they show that only 0.8 per cent. of normal persons showed Types I and II, whereas these organisms were responsible for 62.6 per cent. of the pneumonias. From this it would seem obvious that most cases of lobar pneumonia acquire their infections from extraneous sources and cannot be regarded as auto-infections. It must not be concluded, however, that Type IV is entirely without importance in the causation of the disease. Recent analyses, especially some of those made during the war, would tend to show that Type IV may, under certain circumstances, be very virulent and frequent as an etiological factor. It is even claimed by some workers at the present time, though we do not believe their opinions sufficiently founded on reliable evidence, that Type IV organisms seem to be becoming more frequent as causative factors and are showing relatively more virulence than they did when the earlier observations were made.

TABLE 3.—DISTRIBUTION OF DIFFERENT TYPES OF PNEUMOCOCCUS IN MOUTHS OF NORMAL PERSONS *

Type of Pneumococcus	Incidence	
	No. Cases	Per Cent.
I	1	0.8
II	0	0.0
IIa	1	0.8
IIb	7	5.8
IIx	13	11.6
III	34	28.1
IV	64	52.9
Pneumococcus present	116	
Pneumococcus absent	181	
	297	

* Loc. cit.

Furthermore, observations by the Rockefeller Hospital investigators have indicated that the virulent types of pneumococci usually disappear from the mouths of convalescents within three to four weeks, often earlier, and are supplanted by the less virulent Type IV strains. This, too, would tend to show that the first three types were specifically related to the infection of the lungs, whereas Type IV is to be regarded as a relatively saprophytic variety. Interesting information from the epidemiological point of view has been gained from the study of the types of pneumococci found in the mouths of contacts, and Stillman (4) showed that individuals associated with pneumonia patients may frequently harbor organisms of the same type as those infecting the patients. His studies also revealed that the dust in rooms inhabited by such patients may contain virulent pneumococci corresponding in type to those causing the pneumonias.

All these observations represent a reasonable foundation for the supposition that pneumonia may be regarded, to a considerable extent, as an infectious disease which is spread by patients and carriers of virulent types of pneumococci, and in this respect is comparable to other infectious conditions. The older idea, that any individual harboring pneumococci of any type in his mouth may become subject to auto-infection when exposed to cold and wet, is rendered increasingly less probable, and we must conclude that the acquisition of a virulent pneumococcus from an extraneous source, either directly from a patient or a carrier or indirectly through sputum or dust, is a necessary premise for the occurrence of the disease.

With the above knowledge at our disposal, it goes without saying that our attitude toward the sanitary control of pneumonia must be changed materially. We must now recognize that in this disease, as in many others, precautions must be taken to segregate patients and to prevent the promiscuous transmission of sputum as in sneezing, coughing, spitting, etc., among individuals of an indoor group.

There is, however, another factor in the sanitary control of pneumonia which is of as great importance as (in our opinion of greater importance than) the mere prevention of transmission of infectious material. To elucidate exactly what we mean, it will be necessary to digress briefly. In all communicable disease two dominant factors are concerned in the infection of one individual by another. The first of these is the *transmission* of the infectious agent by proper routes and in sufficient dose.

The other is the *susceptibility* factor of the newly invaded host. In many conditions such as smallpox, measles, scarlatina, plague, glanders, etc., and to a lesser extent in such diseases as cholera, typhoid fever and influenza, the *susceptibility* of the normal, previously unexposed human being is so high that few will escape infection if for the first time brought into contact with a sufficient dose of the virulent causative agent under proper conditions. Here the effort of the sanitarian must concentrate chiefly upon the prevention of dissemination of the infectious material, and, in addition to this, he must seek methods to increase the specific resistance of the population as a whole, such, for instance, as smallpox vaccination and typhoid inoculation.

There are other infections however, among which we place pneumonia and meningitis, in which the resistance of human beings as a class is relatively high. In pneumonia, as in meningitis, the virulent organisms may gain access to the upper respiratory passages of a large number of normal human beings without giving rise to disease. For the development of pulmonary infection a coincidence of two accidents is necessary. One is the acquisition of a virulent pneumococcus by direct or indirect contact, the other is the development of a subnormal resistance due to faulty hygiene. Both factors are necessary, and the chances of their co-existence are great, since an acquired Type I, II, or III pneumococcus may remain in the victim's mouth and throat for prolonged periods; and depressed resistance may be a condition persisting for weeks in environments such as army cantonments or labor camps.

In this latter class of conditions, therefore, while proper precautions against the dissemination of the infectious agents must be taken, the efforts of the sanitarian should concentrate particularly upon the hygienic measures which will, as perfectly as possible, maintain normal resistance.

In both classes, the two dominant factors must be considered, but while in the former the accentuation of sanitary effort must be placed on the transmission factor, in the second group general hygienic control and the maintenance of resistance must be particularly emphasized.

In pneumonia epidemics such as those occurring in some of the military camps, it was quite plain that the susceptibility factor was the determinative one in the incidence of individual infections. Tent-to-tent survey frequently showed that while several cases came from the same tent, often the infections were of different types. The men had been exposed to the promiscuous distribution of sputum, but at the same time had been uniformly subjected to cold, wet, and the unaccustomed work of early military training. Direct transmission from case to case could often be established on a circumstantial basis, but in only a few cases at a certain camp, in which extensive studies were made, were separate cases in the same tent associated with a single type. In this camp there was a regiment of engineers which was on a certain day exposed to unusually difficult weather conditions, incident to a march during a heavy rain with subsequent camping on wet ground. In this regiment twenty-six pneumonias occurred within 16 days. These were analyzed as follows:

In company A which had 7 cases, 4 were Type I.
In company B which had 6 cases, 4 were Type I, and 1 was Type II.
In company C which had 5 cases, 3 were Type IV.
In company E which had 7 cases, 4 were Type I, and 3 were Type II.
In company F which had 6 cases, 3 were Type II, and 2 were Type I.

In one of the companies of this regiment in which cases had occurred, twenty-five men who were healthy, except for colds in the head, were examined to determine whether or not carriers of virulent organisms had developed, and eight of the twenty-five were shown to be carrying virulent pneumococci or streptococci. These individuals did not come down with pneumonia. From evidence such as this, we conclude that, while of course the infectious agent must be transmitted, and attention to measures preventing this must not be relaxed, the more important phase of pneumonia prevention lies in protection against cold, exposure and wet, proper feeding and avoidance of overwork — in short, proper hygienic supervision. If, added to this, crowded sleeping is prevented and ventilation in quarters enforced, we are convinced that the lobar type of pneumonia will drop to a minimum.

When a case of pneumonia occurs, therefore, the sanitary control should proceed along two distinct lines, as follows:

The case should be segregated either at home or, preferably, in a hospital. The segregation need not be absolute, that is, in a separate isolation room, but the patient should be separated from other patients or from his family by screens of paper or of linen hung from strings or frames, so that sputum cannot contaminate others directly or indirectly. Nasal and bronchial secretions should be sterilized, and attendants should be advised to wear masks. When many cases are assembled in a hospital ward, the screening of cases should be a rule and the wearing of masks should be strongly recommended. This last precaution is not so much for the protection of the doctors and nurses themselves, but rather because of the possibility of their becoming carriers.

General prophylactic measures in the unit from which cases of pneumonia have been taken must again restrict themselves to the general measures advised for respiratory disease control in preceding paragraphs. Again, special importance should be attached to prevention of dust, temperature conditions, draughts, drying rooms for clothing, and the changing of wet underwear before exit into the cold evening air in the case of individuals engaged in labor that causes them to perspire. The crowding of sleeping quarters is of particular importance, and special rounds of visits to the homes of workers with advice concerning this should be made. Dryness of shoes and socks, changes of socks during the day, etc. — in fact, all common sense measures for the prevention of mild catarrhal respiratory disease must be taken.

In the interest of future knowledge as well as of successful therapy, it is strongly advised that whenever laboratory service is available type determination should be made on the cases and, if possible, on the families of the patients and on working associates. This will not only be interesting for the individual problem, but information of this kind will contribute materially to future knowledge of pneumonia.

Prophylactic vaccination against pneumonia has been attempted. Inoculations on a large scale were tried by Wright (19) as early as 1911, but since this work was done before the importance of type determination had been discovered, its significance cannot be properly evaluated. Lister (20) more recently carried out prophylactic inoculation against various types of pneumococci among the workers in mines in South Africa. He used carefully typed cultures and injected as many as seven billion intravenously. His final procedure was to administer three subcutaneous doses of two billion of his Types A, B, and C (C and B corresponding to American Types I and II, respectively) at seven-day intervals. He reports a definite drop in morbidity and mortality rates among miners thus inoculated. His results are distinctly encouraging. In this country the only large experiment so far carried out is that of Cecil and Austin (21) in which 12,519 men were vaccinated at Camp Upton against Types I, II, and III. The results of this experiment, though encouraging, are inconclusive. During a ten-week period following the experiment no cases of pneumonias of Types I, II, and III (the organisms used in the inoculations) occurred among the vaccinated. But only twenty-six cases occurred among 20,000 controls during the same period. Furthermore, the incidence of pneumococcus IV and streptococcus pneumonias was less among vaccinated than among unvaccinated. Since the vaccine contained none of these organisms, this fact would incline us to believe that some other factors of general hygiene were in force among the unvaccinated which made them a more protected group than the controls. All that one can say about prophylactic vaccination against pneumonias is that its value is, so far, an unknown quantity, but that preliminary work has been encouraging and should lead to further study without too much delay. While it will probably never attain the sanitary importance of typhoid vaccination, owing to the rare occurrence of true pneumonia epidemics in civilian life, nevertheless, it might be of inestimable life-saving value at times of epidemic occurrence in labor camps and similar groups.

Meningitis

While infection of the meninges may be caused by a large number of different bacteria, there is only one form which is epidemiologically important. This is the disease spoken of as epidemic cerebrospinal meningitis, which is caused by the meningococcus and which may be transmitted from person to person with the discharges of the upper respiratory passages.

Epidemics of this condition have been

frequent in many different parts of the world during the last 150 years. And from the point of view from which we are discussing it in the present connection, it is important to note that, in the train of epidemic outbreaks, sporadic cases and small-group infections trail along for periods of years. In 1903, 1904, and 1905 there was a severe epidemic on the Eastern seaboard of the United States, centralizing particularly in New York where there were hundreds of cases. Following this, the disease extended to Canada and the Middle West and Western states, and since that time it has been more or less endemic throughout North America. During the war the first severe outbreak on the western front occurred among Canadian troops camped on Salisbury Plain, and remained, thereafter, a problem of considerable seriousness among allied troops, at least among those stationed in back areas and in mobilization camps at home. According to studies of Vaughan and Palmer (11), the highest morbidity rate in any camp in the United States occurred at Camp Jackson where it reached 25.7 per thousand, the death rate being 7.05. It was the most serious illness next to pneumonia that occurred in the army camps, chiefly because of its high mortality and because, as Vaughan states, "of all diseases meningitis showed the greatest excess over the disease in civilian communities." Vaughan estimates that meningitis was forty-five times as frequent in the army as in civilian life, a fact which is important in pointing out the serious effect upon meningitis rates of crowded living under conditions which favor catarrhal inflammations of the upper respiratory passages.

The meningococci leave the body of the case or carrier with the mucus of the naso-pharynx and upper respiratory passages, and enter the new host by the same route. Received into the naso-pharynx of the newly invaded individual, the organisms probably pass into the meninges, through the lymphatics, directly into the base of the skull. It is also possible, however, that they reach their final place of lodgment by way of the blood stream. The former route is probably the more frequent, although our knowledge on this particular point is still defective and subject to possible alteration. British writers in the early periods of the war called attention to the fact that cases of meningitis occurred in which the organisms could be isolated from the blood stream before the spinal fluid showed infection. A recent study by Herrick (22), made at Camp Jackson, has laid considerable stress upon this type of case, and this writer concluded that the disease may, in most instances, consist of a primary meningococcus sepsis, to which the meningitis is secondary. He claims that the diagnosis can be made in the pre-meningitic stage in at least 50 per cent. of the cases. This observation is of great importance, not only in indicating that the organisms gain access from the naso-pharynx to the blood before reaching the meninges, but also because it points to the great importance of early blood culture in clinically suspected cases and of intravenous as well as intraspinal treatment with serum.

However that may be, it seems that the organisms actually enter the new host through the naso-pharynx, where they lodge either on a normal mucosa or more likely find suitable lodgment upon a slightly inflamed soil. Indeed, Flügge (23), during the early years of carrier investigations, claimed that the meningococcus was associated in the throat of carriers with definite inflammatory reactions. This view, we think, cannot at the present time be maintained since many carriers may present perfectly normal mucous membranes.

As in other diseases, one must of course consider the actual case as an important source of distribution. However, it has been noted in a great many epidemics that doctors, nurses, and others in direct contact with cases do not very often contract the disease; and, furthermore, the patient is limited in his possibility of transmission to the few individuals taking care of him. The relative immunity of persons in direct contact with a patient has been noted again and again, not only in such epidemics as the one in New York City, where only a few doctors and nurses contracted the disease though they were, of all people in the community, the most frequently and directly exposed, but it has also been noted in British hospitals during the war. An editorial in the *British Medical Journal* of 1916 mentions a British hospital in which 161 cases were treated without any infections among the staff, although many carriers developed in the hospital personnel. This is a point to which we will return later, since it has considerable importance in the interpretation of epidemiological data.

Of much more epidemiological importance than the case, therefore, is the carrier. Carrier examinations were begun by Albrecht and Ghon (24), and since 1901 have been the subject of numerous investigations. The earliest researches must be largely discounted by the fact that nothing was known about the types of meningococcus, and the bacteriological diagnosis of the Gram-negative cocci obtained from throats was not reliable in the modern sense. Although observers like Ostermann (25), Kutscher (26), and others *did* make use of agglutination with immune sera for identification, they did not have polyvalent meningococcus sera at their disposal, and such enormous percentages of carriers as those found, for instance, by Ostermann, who discovered seventeen carriers (74 + per cent.) in a group of twenty-four individuals in a single family in which a case occurred, exceed our modern observations to such a degree that it seems likely that he may have included non-pathogenic species. The pitfall of meningococcus-carrier examinations is the fact that a great many of the Gram-negative cocci from the pharynx agglutinate spontaneously in normal horse serum. Insufficient attention to this is not an attribute of the earlier investigators alone.

The intensive study of the meningococcus-carrier problem during the war has given us much additional information, and the more recent work has been based on a careful definition of what can be regarded as true meningococcus. The method, at present practiced, consists in making smears from the posterior and upper parts of the pharynx upon carefully prepared and tested media, picking and staining suspected colonies, transplanting these and agglutinating them against polyvalent meningococcus serum, with suitable control against the possible error of spontaneous agglutination in horse serum. We omit the bacteriologically technical details as not pertinent to the subject of our present discussion. We may add, however, that although our bacteriological definition of meningococci is sufficiently sound for the determination of species relationship, there is still a serious gap in our epidemiological knowledge, owing to our inability to distinguish between virulent and avirulent strains of true meningococci. In the case of diphtheria, pneumonia, and some other diseases, we possess methods of telling the difference between an organism that is capable of inciting disease in the human being and one that is harmless or relatively so. We cannot tell, at the present time, whether or not an agglutinable Gram-negative diplococcus isolated from the naso-pharynx is capable of inciting meningitis. No constant differences between pharyngeal strains and spinal-fluid strains have so far been apparent, and until this defect in our knowledge is corrected we must necessarily infuse a certain amount of conjecture into our views concerning the epidemiology of the disease.*

Carrier examinations were made on a large scale during the war by the bacteriologists of all the allied forces. Of special importance are the intensive studies made by the British who established a central meningococcus laboratory under the directorship of Gordon (27). The figures obtained by English bacteriologists were, in a general way, identical with those obtained elsewhere, and have revealed a number of important statistical facts. Bassett-Smith (9) in examining 26,543 men of the Royal Navy found 4.7 per cent. positive in 1917, as against 2 per cent. in the preceding year. Tulloch (28), examining 10,000 men, obtained 324 Gram-negative diplococci of which 221 or 2.21 per cent. were true meningococci of various types. In this country, Mathers and Herrold (29) found 4.4 per cent. carriers among 15,257 men in the Great Lakes Naval Training Station, and of these 1.2 per cent. were chronic carriers. A frequent observation made by a number of writers is the fact that the carrier rate goes up during the cold months of the year and during the prevalence of catarrhs. Bassett-Smith found the highest incidence during May, following a cold

* It is not at all impossible, too, that we may not as yet include in our polyvalent sera all the strains which can cause meningitis. Until 1909 the meningococci were considered as a homogeneous group. In that year Dopter discovered that serum agglutination can differentiate the ordinary type meningococcus from others which he calls the parameningococcus, an organism which occurred frequently in the spinal fluid of cases. Classifications of virulent meningococci were then worked out by numerous investigators, and at present a number of different classifications have been adopted in different countries. Gordon has attempted to subdivide meningococci into four main classes, I, II, III, IV. Type I of the English classification corresponds to the parameningococcus of Dopter; and Type II, to what both the French and American Schools speak of as the normal meningococcus. Types III and IV include the various organisms which in the United States are spoken of as intermediates, but there are so many minor differences between individual organisms that polyvalent sera produced in horses by a large number of strains must be used for diagnosis.

April, during which there was a great deal of mild respiratory disease among the men.

In regard to the difference between various groups of men within a camp, the figures of Mathers and Herrold are interesting in that they show a definitely high carrier rate among individuals in contact with cases. As stated above, they examined 15,000 men of whom 3.6 per cent. were positive. A limited group of convalescents showed 38.2 per cent. positive. Hospital Corps men showed 13.5 per cent. positive; contacts showed 26.7 per cent. positive; non-contacts showed 4.4 per cent. positive. The chronic carriers, as previously noted, were 1.2 per cent., and in such persistent carriers pure cultures were often obtained. An extremely interesting series of studies on this problem are those of Glover (30) upon the influence of general sanitary measures, especially the spacing out of men in sleeping quarters, upon the carrier rate. In a unit in which meningitis was occurring and in which crowded conditions prevailed, Glover examined a barrack company repeatedly before and after careful spacing out of the men in sleeping quarters had been arranged. The table he constructed is given above as Table 4. It shows the most striking differences as a result of this simple preventive measure.

TABLE 4. — EFFECTS OF "SPACING OUT" ON "SEVERELY OVERCROWDED" BARRACK-ROOMS *

Unit	Date of First Swabbing	Percentage Carrier Rate before Spacing Out	Period Spaced Out Approximately	Date of Second Swabbing	Percentage Carrier Rate after Spacing Out
No. 1	Sept. 29	22.0	8 weeks	Dec. 6	2.0
No. 2	Oct. 2	28.0	6 weeks	Nov. 23	7.0
One room of No. 2	Oct. 2	38.5	6 weeks	Nov. 23	4.5
No. 4	Oct. 26	28.0	5 weeks	Nov. 30	4.5

* Glover, loc. cit.

It is of course logical to expect that there should be a definite relationship between the rise of carriers in a community and the number of cases which come down with the disease. This relationship has, indeed, been determined in such studies as those of Meleney and Ray, who traced fourteen out of twenty-four cases to carriers, and found parallelism between cases and the rise of carriers. It has not, however, been universally possible to demonstrate such relationship. Frequently groups including large numbers of carriers have not developed cases. Such instances as those noted above in connection with hospital personnel, as well as studies by Short (31), are interesting in failing to show any parallelism between carrier rates and cases. We quote from Short's report on the outbreak at the United States Naval Training Station at Great Lakes, Illinois, as follows:

"It will be seen at once that although there was a sudden rise of cerebrospinal fever early in January there was no previous increase over the usual carrier index, which did not begin to rise until the middle of January, two weeks later; while the peak of the greatest case incidence, and the percentage of carriers continues high for several weeks after the case curve has begun to decline. The smaller rise in carriers and cases during December, 1917, is synchronous in the chart, but on plotting the daily figures the rise in carriers is found to come a week later. This relation cannot be demonstrated in the rise shown in October, 1918, owing to the lapse of several days during this period when no cultures were taken. On account of the time factor brought out by the comparison of these two curves, it is difficult to account for the new cases on a basis of an increase in carriers, and it seems more logical to assume that the carriers are the result rather than the cause of the epidemic. Strength is further added to this assumption by the fact that while the small number of known carriers who preceded the epidemic had been very carefully isolated, on January 28, 1918 (when the carrier incidence had nearly reached its height) the restrictions on carriers were largely removed and no attempt was made to isolate those subsequently discovered. In spite of the great prevalence of unrestricted carriers when just beyond the peak of the case curve, the epidemic continued to decline. Another instance of the comparative harmlessness of carriers may be noted in this connection. A carrier (C. R. F.) who had been in isolation for several months at this time was placed on duty in an office under ordinary conditions. Cultures were taken at regular intervals and were continued in all over a year. At no time could he have been discharged under the system of obtaining three successive negative cultures, and yet, in spite of his carrying this organism for a year without any especial precautions, no new cases of the disease developed among his associates, nor could any new cases be traced to this carrier."

The epidemiological data concerning the spread of meningitis, therefore, lack a great deal in clearness, and there is much that needs to be further studied before we can develop a complete and satisfactory method of handling the disease. However, we can even now formulate certain definite principles which will help us in properly

managing epidemic outbreaks. In our own opinion, the conditions are something as follows:

The meningitis carrier, like the typhoid and diphtheria carriers, represents a constant menace in civilian populations. The carrier rate is probably higher than 3 per cent. or 4 per cent., since studies that have been made must necessarily fall below the actual number. In making the examinations, swabs are taken from one part of the pharynx only; carriers in whom the organisms are lodged high up in the nasopharynx or ethmoidal passages, and those with few meningococci present at the time of examination, may show nothing on the plates, or a very few colonies may easily be overlooked. During periods of cold and wet with general distribution of catarrhal infections of the respiratory passages, the carrier rate goes up. This rise is enhanced wherever crowded living quarters prevail, and where people work and sleep under conditions of bad ventilation and in close proximity to each other. Under such conditions it is only logical to suppose that the carriers increase in number. Why, on the other hand, we must ask ourselves, does the disease under such circumstances select isolated individuals instead of becoming generalized, and why do so many people in contact with cases escape infection, especially as we know that the carrier rate is particularly high among these contacts? The answer, we think, lies along lines of thought similar to those outlined in connection with pneumonia. There is a great difference between individuals in susceptibility to meningococcus infection. We think that experience and the figures available show that most human beings have a high resistance against meningococcus. The susceptibles in the community are relatively few. Unlike pneumonia, the resistance is not so intimately related to temporary physical condition, but rests upon something more specifically fundamental, perhaps congenital, perhaps acquired in youth by naso-pharyngeal infection with meningococci. At any rate, there are such differences. When we try to trace cases to a single carrier, we are often astonished by the fact that in a large group only one or two individuals who have been in contact contract the disease, and that many habitual associates of a man who comes down with the infection are not carriers. This is, perhaps, due to the fact that contact sufficient to infect an individual with meningococcus is not necessarily a habitual one or a very close one. A susceptible who may have been living habitually in a group of twenty or thirty people may get his infection accidentally in a street car, in a moving picture show, or in the passing brief association with someone who has no relationship whatever with his habitual group. It is this fundamental difference in susceptibility which we believe explains the irregularity of epidemiological studies. A marked difference in the virulence of meningococcus strains, depending, perhaps, on the length of time they have been leading a saprophytic existence on the mucous membrane of an insusceptible, may also play a rôle in this phenomenon. However, this is purely a matter of conjecture.

What probably happens in an epidemic in a limited group of individuals is that there are, from the beginning, a definite number of carriers and a definite number of susceptibles. When respiratory catarrhal conditions prevail, the organisms are spread, more carriers develop, and the opportunities for the infection of susceptibles increase in geometric ratio. The habitual contacts of a carrier may be insusceptible, but a susceptible may come into brief temporary contact with a carrier and get the disease. When susceptibles have been infected the epidemic subsides, and it is not impossible that this is the chief reason for the decline in epidemics in camps and communities to which no new members are admitted during the disease. Often we may have flattered ourselves that we had stopped the disease by segregation of the cases, when the fire had burned itself out because the combustible material was used up.

The question arises — what shall we do to prevent the spread of meningitis in a group in which one or several cases have appeared? The answer to this question will vary according to the nature of the group under consideration, its average age, its size, environment, and variety of occupation. If we are dealing with large military communities among which cases are scattered, we do not think it advisable to make complete carrier examinations. It is better there, we think, to use the British method of determining a carrier rate, that is, examining 50 or 100 individuals promiscuously chosen, in order to ascertain

whether the carriers are increasing to an alarming extent, and measuring the degree of drastic sanitary interference by the danger signal of the carrier percentage. If we were dealing with factory communities or schools of a size sufficiently limited to permit accurate, complete investigation, we believe that repeated and systematic carrier examinations should be made, and the carriers excluded from association with others.

Important as we judge such attention to carriers, more important still for the prevention of meningitis, we believe, is immediate attention to the improvement of sanitary conditions in relation to respiratory infection. When meningitis occurs in such a group we would immediately make physical inspection of all members of the group, and would segregate those sneezing and coughing, excusing them from work if necessary, advising them as to precautions in the families, and attempting in this way to prevent a generalization of catarrhal respiratory infections. The sleeping quarters of the personnel either in their homes or in dormitories should be carefully scrutinized, and advice given if enforcement in the homes is not possible. Ventilation, prevention of sleeping in the same bed, caution against spitting, coughing, and hawking should be strictly attended to. The temperature of the working space and the ventilation should be regulated, and provisions made so that no one works in wet clothing or shoes, or leaves the building in a perspiring condition without change of clothing or previous drying. In short, all the measures should be taken which will reduce the general respiratory sick rate in order to prevent the formation of a vicious circle by which the number of carriers is increased. In a battalion of infantry in which five cases of meningitis occurred within a short period, we found that the daily sick call from mild respiratory infection amounted to over 250 a day. Attention to the simple matters mentioned above, together with prevention of overwork, etc., reduced the sick call to something over twenty a day. Coincident with this, meningitis disappeared.

A difficult problem is that concerning the disposition of the carrier. Many attempts have been made to free carriers of their meningococci by antiseptics of various kinds. Dichlorimine-T, potassium permanganate, chlorine, etc., have been used — all of them without satisfactory result. The most promising method of treatment was that developed by Gordon, Flack, and Hines (27) who sprayed a 2 per cent. solution of zinc sulphate mixed with steam into chambers into which the carriers were led for seven or eight minutes at a time on successive days. It is doubtful, however, whether any of these procedures will be found reliable. In most cases general hygienic measures, life in the open air, prevention of catarrhal infection, and general establishment of health of the mucous membranes is the most satisfactory method of curing carriers. There will always be a certain number of cases in whom it is quite impossible, in spite of persistent treatment, to remove the organisms permanently. What we are to do in such cases, only further study can disclose.

Diphtheria

Diphtheria as an epidemic disease is a problem of relatively small importance among adults and would naturally play a rôle of less importance in connection with factory hygiene than it does in the sanitary problems of schools. Resistance against diphtheria can be measured with more or less accuracy by determination of the amount of antitoxin circulating in the blood, and numerous measurements have been made to ascertain the approximate immunity to diphtheria enjoyed by the average human being. In the blood of newborn infants there is usually a definite amount of antitoxin and this is generally sufficient to protect against the ordinary diphtheria infection up to the age of about one year. This antitoxic property is inherited from the mother, probably transmitted through the placenta, perhaps to some degree through the colostrum during the first days of lactation. This, however, is a problem that needs re-examination and is of no particular importance in this connection. From the age of one year at which the protective value of the blood serum is at its lowest ebb, there is a gradual increase of its antitoxic properties and it attains its maximum value in vigorous adult life. Measurements of antitoxin content in the blood of human beings at various ages such as those made by Hahn (32) and Schick (33) are given in Table 5. These figures represent averages, of course.

It must be remembered that there are

great differences, etc., between individuals, and it is not unlikely that in the same person there may be temporary fluctuations of antitoxic values. The fact remains, however, that in the problems of adult sanitation diphtheria as an epidemic disease is not as immediately important as it is in connection with the health supervision of children. Nevertheless, the disease occurs and, under conditions of crowding during the cold months of the year, may become an important problem of sanitation. In two particular divisions of the army in France extensive outbreaks of diphtheria occurred in which it took a long time to arrest the disease. It is probable that a similar situation could arise in connection with factory groups. It will be important, therefore, to consider some of the principles upon which protection against diphtheria is based. The source of diphtheria, apart from the case itself, may be either transmission by carriers or by food.

TABLE 5.—ANTITOXIN CONTENT OF HUMAN BLOOD

	Age	Cases with Antitoxin Serum	Cases without Antitoxin Serum	Highest Antitoxin Value in 1 c.c.
Schick	Newborn	11	0	under 1.5 units
	0–1 year	1	3	0.11 unit
Hahn	2–10 years	7	5	1.00 unit
	11–20 years	8	9	0.75 unit
	21–30 years	9	5	2.5 units
	31–40 years	5	1	0.15 unit
	41–65 years	2	8	2.5 units

Food transmission is numerically less important than that by carriers. In the former the disease appears in explosive, circumscribed epidemics; in the latter it is sporadic and may originate in many different foci simultaneously. Among food products the most frequent source of transmission is milk (34). Milk epidemics have been reported and studied for a great many years. In all such cases the outbreak is of an explosive nature, suddenly affecting a considerable number of persons, and upon study it can be found that most of the people affected have taken milk from the same source. Neisser (35) studied an epidemic in Frankfurt in 1903 in which there were ninety-seven cases, mostly adults, traceable by reliable circumstantial evidence to milk. The organisms have been isolated from market milk by Bowhill (36), Eyre (37), Klein (38), Dean and Todd (39) and many others. Dean and Todd reported an epidemic in which they claimed to have obtained diphtheria bacilli from ulcers in the udders of cows and from the milk. The organisms were virulent for guinea pigs. They could not transmit diphtheria bacilli from udder to udder and concluded that the ulcers were primarily streptococcus infections, secondarily infected with diphtheria bacilli. Eyre showed that the organisms could proliferate in milk. Since 1895 there have been fifteen probable milk epidemics in the United States. In some cases, diphtheria has occurred at the dairy and in the milk shop among the personnel which handled the milk. There have been epidemics in Dorchester and Milton in which careful epidemiological studies have connected the outbreak with the milk supply without much possibility of doubt. Thus, whenever explosive outbreaks, affecting a considerable number of persons at one time, occur in a circumscribed community, milk, cream, and ice cream must be thought of and accordingly investigated.

Much more important than food, etc., from the point of view of general diphtheria prevention, are the unrecognized case and the carrier.

Simple sore throat, mild pharyngitis, and tonsillitis may frequently reveal, on bacteriological examination, the presence of diphtheria bacilli without the appearance of any of the characteristic clinical features of the disease. This is especially true of such epidemic outbreaks as those in the army which occurred among individuals of relatively high resistance, where the true diphtheria infection may be so rapidly overcome by the resistance of the patient that it is never recognized in its true character. We have noticed this not only in connection with army sanitation, but also in civilian practice among adults. In patients of this age-group also, diphtheria bacilli may be present when the dominating clinical picture of the throat is one of Vincent's angina or of streptococcus inflammation. One is often astonished to find diphtheria bacilli present in such throats when a clinical picture did not particularly suggest diphtheria, and when the condition yielded readily to non-specific treatment. It is, therefore, an important principle in the prevention of diphtheria to regard all but the very mildest cases of sore throat as

suspicious, at least to the degree of insisting upon cultures. The taking of cultures is such a simple matter and reliable results are obtained with so little difficulty that there is no excuse for omitting cultivation in sore throats of any severity.

More important for the actual spread of the disease, certainly of greater importance than other factors in endemic persistence, is the diphtheria carrier. This has been recognized for a long time. It is by no means necessary for an individual to have had diphtheria to become a carrier. In the work of Moss (10) and his associates, three only of forty-nine bacillus carriers gave histories of having had the disease, and it is also a fact that relatively few of the carriers develop the disease in the course of their carrier state. Both of these observations show that there may be no indication to point to an individual as a probable carrier except the discovery of epidemiological relationship to developing cases.

The existing number of carriers is a clear index to their importance. A tabulation of the work of various observers between the years 1895 and 1907 made by Goldberger and Williams (40) indicates that out of 200,132 non-exposed persons examined, 0.18 per cent. were carriers of virulent diphtheria bacilli. Later examinations made by Goldberger and Williams themselves, on some 4093 healthy people in the city of Detroit in 1914, showed 0.928 per cent. to harbor morphologically typical bacilli and 0.097 per cent. were carriers of virulent bacilli. Moss and Guthrie, in examinations made on 1217 public school children in Baltimore and 1290 individuals in the city at large, found eighty-nine positive cultures or 3.55 per cent. Of these only eighteen and a fraction per cent. were virulent. These figures are imposing when we calculate from them the probable number of carriers found in large cities. According to Moss and Guthrie's (10) results, calculated on the basis of 600,000 people in Baltimore at that time, there were probably 20,880 carriers of morphologically typical diphtheria bacilli in the city of Baltimore, and it is likely that this is below the actual number since these figures are based on single examinations.

The chances are, therefore, that in every group of individuals gathered together for industrial purposes there are a certain number of diphtheria carriers, some of whom may harbor virulent bacilli, and it is more than likely, as our experience in the army has shown, that under conditions of the extensive occurrence of coughs and colds the percentage is considerably increased. We remember one small epidemic in a machine gun battalion which we had an opportunity to study in France (we quote this from memory; the report is not immediately available at the present moment, but we feel fairly sure that we are quoting without great inaccuracy) in which seventeen diphtheria carriers were found in a unit of not over ninety men. In this company there was a very high rate of mild respiratory disease, coughs, colds and bronchitis. Two of the carriers in this unit were among the cooks, and the importance of the examination of the kitchen personnel for the diphtheria carrier state, as soon as cases occur in the groups eating at a common mess, is a matter that requires attention. While most carriers seem to give no history of diphtheria, we must not forget that convalescents from diphtheria may also harbor the bacilli for considerable periods. This is mentioned merely in passing since, of course, it is common practice to hold diphtheria cases until two or three successive negative cultures have been obtained, the first one taken not less than ten days after the first positive culture.

Although most diphtheria carriers yield rather easily to treatment there are, nevertheless, certain individuals who may be designated as chronic carriers in whom bacilli will survive for months and even years in spite of the most vigorous efforts to dislodge them. Therefore, if in the course of the preventive measures outlined below a carrier should be discovered, it is necessary to remember that prolonged observation of this individual with perhaps segregation may become necessary, and that repeated cultures, both from the nose and pharynx, should be practiced before the case is dismissed from observation. Based on these considerations, the management of a group of workers among whom diphtheria occurred would be a relatively simple matter, and spread of the disease can be easily prevented if the necessary steps are taken with speed and energy.

On the occurrence of a case either in a worker or in a member of a worker's family, immediate attempt should be made to trace the possible origin. If contact with a recent case or convalescent can be established, the task is rendered relatively simple, and if the

circumstances seem to be sufficiently clear it may not be necessary to proceed farther. As a rule, however, this will not be possible. In that case, it is not unlikely that the disease may have been picked up from a carrier in the plant, though it will be quite impossible to trace all contacts of the diseased individual, since much of his exposure during weeks preceding the onset of the disease may have taken place in public vehicles or places of amusement. A series of throat cultures taken from his working associates, the members of his family, and if there is a common mess from the kitchen personnel, will settle this matter within a few days. It should be borne in mind that cultures must be taken not only from the pharynx and throat, but from each individual a nasal culture should be taken at the same time. If a carrier is found, it is necessary to determine whether or not the organisms found in the carrier are virulent. This the laboratory can easily determine by isolation of the bacilli and guinea-pig inoculation (41).* Should the organisms from the carrier prove to be virulent, immediate isolation will remove this particular source of infection.

It is questionable whether it is wise to go further than this in adult industrial establishments in which the measures adopted must be taken with the consent of the workers. Probably it would be better to do nothing further than to insist generally upon the rigid observance of established sanitary regulations. But should more cases occur and the situation take on the appearance of an epidemic, a more energetic procedure would be indicated. In addition to the taking of cultures the Schick reaction (42) † should be carried out upon all possible contacts. The reaction is easily carried out, and will show within forty-eight hours which are the susceptible members of the group. All individuals showing a positive Schick reaction should receive a prophylactic injection of from 500 to 1000 units of diphtheria antitoxin.

The problem again arises as to the disposition which should be made of chronic carriers. Most of these will clear up spontaneously as complete health of the upper respiratory passages is established. Mild alkaline or saline solutions may help. Antiseptic treatment has been unsuccessful as a general thing, and it is not impossible that drastic treatment such as that with iodine and weak formaldehyde will do more harm than good. Implantation on the throat with staphylococcus aureus cultures, recommended by German experimenters and also by Ravenel (43), has not had sufficient application to be carried out, and might under certain circumstances prove a dangerous procedure. Perhaps the most important method of treatment of such carriers is the correction of abnormal conditions of nose and throat with especial attention to naso-pharyngeal septa and removal of hypertrophied tonsils and adenoids.

A method of immunization against diphtheria has recently been worked out in which over-neutralized mixtures of toxin and antitoxin have been injected (44). The mixtures are made of about 85 per cent. of an L + dose of toxin per unit of antitoxin, and about 1 c.c. is injected at a time. Three such injections, according to Park and Zingher (45), at intervals of six or seven days will slowly develop antitoxin and produce an active immunization which lasts much longer than that obtained by simple prophylactic antitoxin injections. It is probable that this method will be extensively needed in the future.

* *Virulence Test.* — Two c.c. of 28-hour broth culture is injected into a normal guinea pig; a similar control injection is made into a guinea pig of 250 units of antitoxin. A more economic method consists in injecting intracutaneously 0.15 c.c. of a diphtheria salt solution into a guinea pig, making similar injection into a previously immunized guinea pig, reading the result according to whether a necrotic lesion forms in the unprotected pig. By this method four or five cultures can be tested on two pigs.

† *Schick Reaction.* — The Schick reaction is a test, the purpose of which is to determine whether an individual is protected against diphtheria by the antitoxin normally circulating in his blood. A standardized diphtheria toxin in salt solution is 0.1 c.c. of solution containing 1/50 M.L.D. This amount is injected gradually into the subject on the skin of the upper arm. A control injection of 1/50 M.L.D. of the toxin heated to 80° C. for five minutes should be made at the same time in order to control the Sudo reaction due to the protein contained in the broth in which the diphtheria bacilli have been grown. A positive reaction, which indicates that the blood contains 1/30 of a unit per c.c., shows within 24 hours a slight marking of the skin in the form of a red halo, 1 to 2 c.c. in diameter. This may not appear until 48 hours, and subsides very gradually. Individuals with negative Schick reactions are usually protected sufficiently to dispense with prophylactic antitoxin injection.

(To be continued)

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BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Towards Racial Health. A Handbook for Parents, Teachers, and Social Workers on the Training of Boys and Girls. By Norah H. March, B.Sc., M.R.San.I. With a Foreword by J. Arthur Thompson, M.A., LL.D., Professor of Natural History in the University of Aberdeen, and an Introduction by Evangeline W. Young, M.D. Cloth. Pp. 246 and appendices. New York: E. P. Dutton & Company, 1919.

Textbook of Meat Hygiene. With Special Consideration of Antemortem and Postmortem Inspection of Food-Producing Animals. By Richard Edelmann, Ph.D., Medical Counsellor; Royal State Veterinarian of Saxony; Professor at the Royal Veterinary High School in Dresden. Fourth revised edition by John R. Mohler, A.M., V.M.D., Chief, U. S. Bureau of Animal Industry, and Adolph Eichhorn, D.V.S., Director, Veterinary Department, Lederle Antitoxin Laboratories; Formerly Chief, Pathological Division, U. S. Bureau of Animal Industry. Cloth. Pp. 472 with index. Illustrations. Philadelphia: Lea & Febiger, 1919.

Pellagra. By H. F. Harris, M.D., Atlanta, 1919. Cloth. Pp. 421 with appendix, bibliography and index. Illustrations. New York: The Macmillan Company, 1919.

BOOK REVIEWS

Industrial Medicine and Surgery. By Harry E. Mock, B.S., M.D., F.A.C.S., Assistant Professor of Industrial Medicine and Surgery at Rush Medical College; Attending Surgeon, St. Luke's Hospital; Visiting Surgeon to Washington Boulevard Hospital; Chief Surgeon to Sears, Roebuck and Company; Fellow Institute of Medicine, Chicago; Lieutenant-Colonel, Medical Corps, U. S. A. Pp. 846, with bibliography, index and illustrations. Philadelphia: W. B. Saunders Company, 1919.

Physicians in industry will all be interested in Lieutenant-Colonel Harry E. Mock's recent textbook, *Industrial Medicine and Surgery.* Colonel Mock has treated the subject from every possible angle and has availed himself of every source of information obtainable. His position in Washington gave him the opportunity to acquire information upon reconstruction and similar subjects which could not be obtained elsewhere, while he has not hesitated to draw upon those best qualified to contribute chapters on special subjects.

Doctor Mock has considered his subject from the broadest angle, considering carefully many of the service problems which are being so freely discussed today. The book abounds in detail and will prove a very valuable guide to those just entering the practice of industrial medicine and surgery. Certain chapters should be carefully read by employment managers, safety engineers, and others interested in the question of personnel.

The book is divided into six parts. The first upon industrial health service covers health supervision with its fundamental ideas, the type and equipment of plant hospitals; the selection of a medical staff with a description of its duties; the duties of the nurse in industry; the advantage of an employees' dental service, and finally an illustration of the running of an industrial medical department taken from a factory maintaining such a system. The division continues with a discussion on the cost of the medical department, the supervision of the health of the managerial staff and the important part taken by recreation and exercise in the supervision of the health of employees. The division closes with a discussion of food, records, and the industrial health service.

The second part is given over to prevention. In this division are discussed such problems as preventive medicine and preventive surgery in industries, industrial hygiene, general and specific problems, health hazards, the National Safety Council, and accident prevention.

The third part deals entirely with the problems of industrial medicine. It considers the medical examination of employees and applicants for work, examination and correction of eye conditions, and the medical treatment of employees. Special chapters are devoted to women in industry and the tuberculous employee.

The fourth part is devoted to industrial surgery and covers the subject thoroughly.

The fifth part considers compensation insurance and medico-legal phases, while the sixth part is given over to reconstruction.

The special chapters put in concrete workable form the answers to many of the problems which are being considered daily by industrial physicians and surgeons, and the book will probably become established as the standard textbook of industrial medicine and surgery in America. — *W. Irving Clark.*

Human Infection Carriers. Their Significance, Recognition and Management. By Charles E. Simon, B.A., M.D., Professor of Clinical Pathology in the University of Maryland School of Medicine and the College of Physicians and Surgeons, Baltimore, Maryland. Cloth. Pp. 245 and index. Philadelphia: Lea & Febiger, 1919.

Of the many valuable contributions to our peacetime life which have crystallized from our experiences in the late war, one of the important ones is the concentration of attention upon the menace of human disseminators of disease. We have appreciated for a comparatively long time what mischief may be wrought by healthy carriers of typhoid and dysentery infections, but the recent epidemiological investigations in our army hospitals have done much to extend our knowledge of the far more widespread and deadly effects of the respiratory disease carriers.

Human Infection Carriers is the outcome of a request of the Surgeon General that medical students be thoroughly drilled in the epidemiological aspects of infectious diseases, including the laboratory phase of the question. Though primarily written for the medical student, it should prove a valuable guide and reference to the epidemiologist and health officer.

The carrier problem is considered only in connection with those diseases due to bacteria or filterable virus, in the dissemination of which healthy human carriers are known to play a rôle. This limitation in scope does much for the clearness in discussion of the following: cholera, diphtheria, typhoid and paratyphoid fevers, dysentery, epidemic meningitis, poliomyelitis, pneumococcus pneumonia, streptococcus infections (like camp septicemia, broncho-pneumonia, septic sore throat, erysipelas and puerperal fever), influenza and pneumonic plague.

Under each disease-heading are discussed: the occurrence of active and passive carriers, the duration of the carrier state, the frequency of carriers, the habitat and virulence of the causative organism, the mode of infection, the recognition of the carrier with a detailed description of the laboratory methods involved, and the management of the carrier from the standpoint of the public health officer. Concrete examples are offered illustrating the menace of the carrier to others. An appendix is included containing the most important state laws, municipal ordinances, and federal interstate regulations dealing with the carrier problem which have been enacted up to the beginning of 1918.

The treatment of the various subjects under dis-

cussion is clear and to the point, and frequent references to recent literature will be of aid to the student. The author has wisely refrained from extended discussion of matter that has not been clearly proven or is imperfectly understood. Occasional typographical errors, apparently unavoidable in first editions, serve to mar the good impression gained, and cause one to wonder if the statistical figures quoted are not also affected in a like manner. — *Barnett Cohen.*

Labour in the Commonwealth. By G. D. H. Cole. Cloth. Pp. 223. London: Headley Bros. Publishers, Ltd., 1918.

The theme of this book is the welfare of the worker, employing the term welfare in a wide sense. Its standpoint is that of the guild socialist; its attitude is ethical; its logic is political; and its temper is revolutionary — although some of these terms need further specification. The workingman's rights have been denied him, and from this infringement upon the fundamental good, i. e., freedom, much else has followed. The industrial revolution is based upon the idea of servitude, and all economic thinking has been dominated by that idea. It has always treated labor as an elementary commodity, and the harm done thereby will never be remedied until the point of view changes to the psychological, and the human being becomes the unit of calculation. The cure consists of the securing, on the part of the laboring class, of its rights; its right to self-determination and to control its own products is a primary good beyond argument — a good in itself to be obtained without any hesitation as to consequences. The means to that end are necessarily in some sense radical, and they are political. That, in a word, is the substance of the book.

It is the relation of this view of labor to specific practical problems that is of most interest to the student of industrial conditions; and it is worth while to observe that these political doctrines tend to antagonize a number of scientific recommendations, especially sociological conclusions, that are widely accepted. Most of the current projects for "reform" and "betterment" are in fact rejected. Lord Leverhulme's panacea of the six-hour day, for example, fails to appeal to the writer because the leisure of which it speaks is nothing but a "rest-pause" to fit the laborer to do better the work of the factory. Joint control of industries by the capitalist and the worker is a half-measure, and retains the class differences that are at the root of the whole trouble. Insurance projects are paternalistic, if not impertinent. The new Education Bill, by which the education of all workers is to be continued to the age of eighteen on a part-time plan, seems to the author to offer too many chances of playing into the hands of the exploiter, and to afford opportunity to separate still further the worker from the owner by making this supplementary education merely a fitting for trade. The educational thinker is the worst of all to contend with because of the apparent truth of what he says.

The real truth is that the great educational need of the masses is equality of education with the other classes. What the worker needs is not education to fit him for a better social and economic position, but the education which comes through opportunity to be self-determining, and in the exercise of rights and powers. Slow processes, whether educational or of any other kind, fail, and in great measure because of the automatic process by which, continually, a large part of the better stock of the laboring class is drafted out and affiliated with the employer class. The change, therefore, if it is to be a change for the better, must be radical. The democratization of industry and of government must be based upon a conception of classes and activities as functional. Trade unionism must reach more and more the expert, the foreman, and the professional worker. The control of industries must not be dual, but completely unified as guild control; and to make this complete, nothing less than a change in the whole principle of representation in government must be made.

The writer's plan, as contrasted with the scheme outlined by Benn and with the Whitley Report, would provide for a more "functional" and more direct control through a double parliamentary plan which, instead of being geographical and representative of the interests of individuals in the present political manner, would express the interests of all "users" in one body and of all "producers" in another, the two parliamentary functions combining only when joint interests were involved. In other words industry would become an independent function, self-determining, working out its own laws and its own plan of education. The attitude of this book, its "politicalism," as contrasted with what might be called the "educationalism" of the scientific point of view, is well indicated by the words with which the writer closes his chapter on Labour and Education: "Oscar Wilde once remarked that all art was absolutely useless. We might do worse than say that all education is absolutely useless. Neither remark is true, but both are inspired lies." — *G. E. Partridge.*

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THE CONTROL OF INFECTIOUS DISEASES IN INDUSTRIAL COMMUNITIES

(Continued)

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II. INTESTINAL DISEASES

The intestinal diseases which are particularly important in our present discussion are the typhoid and the paratyphoid fevers, the milder types of dysentery, and diarrheas of uncertain etiology which not infrequently occur during the hot months and may often assume an epidemic form. Cholera is too rare in this country to be taken into consideration in an article on American industrial conditions, and in considering the diseases mentioned we can illustrate all of the important principles which are involved in sanitary measures for the prevention of intestinal diseases in general.

These diseases are all acquired by ingestion of the infectious agents and are, therefore, conveyed either with contaminated food or by direct or indirect contact with the excreta of a preceding case or carrier. Water and milk, which are responsible for from 10 per cent. to 30 per cent. of all cases of typhoid and paratyphoid fever, are being subjected to such careful municipal and state scrutiny that we need spend very little time discussing them in connection with factory hygiene. The installation of filtration and chlorination plants promises to do away almost entirely with water-borne typhoid and paratyphoid fever epidemics, and a similar control of milk production will probably reduce the incidence from this source to a relatively negligible quantity before many years have passed. Both of these means of conveyance are apt to give rise to local epidemics, the epidemiology of the outbreaks giving very definite clues to origin in water and milk.

Recent studies are tending to show more and more definitely the progressively increasing importance of direct and indirect contact with cases or carriers in the causation of the sporadic cases which occur endemically in all crowded communities. The increasing importance of this method of conveyance, in contradistinction to transmission by water and milk, is shown in such figures as those cited by Schule (46) from the report of the German laboratory at Trèves for 1918 in which the probable origin of typhoid cases is given as follows: Sixty per cent. were due to contact with typhoid cases; 5 per cent. were due to contact with carriers; 1 per cent. was due to water and milk, each. A similar analysis of 5,889 cases taken from the same source attributes 71 per cent. of all cases to contacts. Such statistical material is not absolutely reliable because in many cases the course of infection must necessarily be a matter of conjecture. However, it is unquestionable that contact with cases and especially with carriers is growing more and more important. Such contact may be a direct or an indirect one. Gay (47) summarized the methods with which it takes place by defining five routes along which infectious excretions (chiefly feces) may be conveyed from one person to another:

1. Fingers or utensils — mouth.
2. Fingers — food — mouth.
3. Fomites — fingers — food — mouth.
4. Flies — food — mouth.
5. Fingers — flies — food — mouth.

The first route is the direct one which is of relatively little importance in industrial communities, since it implies direct care of the sick or intimate personal contact with a carrier, such as that to which a nurse, a physician or the mother of a family would be subjected. The prevention of typhoid fever in industrial communities, therefore, will have to do chiefly with the indirect modes of contact, and these, as tabulated, are readily approachable by a definite sanitary routine.

The second route, fingers to food to mouth, can be protected against by systematic cleansing of the hands. Where men bring their own lunches to the factory or counting house there should be ample provision of washing facilities conveniently located in regard to toilets and lavatories in order that it may be easy to inculcate regular habits of hand-washing. The practice of washing the hands before meals should be taught and encouraged, and in time of emergency, supervised. If kitchen and restaurant facilities are provided for the employees, an arrangement should be made for the thorough supervision and examination of the kitchen personnel, and the cleanliness of hands, especially after use of lavatories, should be enforced on penalty of dismissal from the kitchen. Carrier examinations should be made on the workers in such kitchens at the time of employment, since the disease has often been widely spread in this way. One need only follow the well-known career of "Typhoid Mary," which has been recently made the subject of a special publication by Soper (48), to be convinced of the havoc that may be played by a typhoid carrier employed as a cook. This woman is known to have worked for eight families in the course of ten years, during which occurred seven outbreaks of typhoid, directly traceable to her. Since that time this unfortunate woman's movements from place to place have always been followed by circumscribed epidemics. One of the episodes in her career, which occurred in a hospital with which we were associated at the time, might have been prevented had we made the examination of kitchen personnel a routine measure before employment.

The third route, fomites, fingers, food to mouth, is of less importance, since infection by towels, handkerchiefs, underclothing, etc., is not a very likely mode of infection in factories or shops. The general use of paper towels and education in regard to these matters should take care of this.

The fourth and fifth routes both have to do with flies. This is a subject which is of great importance and which has not been sufficiently considered in civilian sanitation. In armies, attention to fly-breeding and the prevention of access by flies to latrines and to food is one of the first principles of disease prevention, and in such diseases as epidemic dysentery and diarrhea, as well as in the typhoid and paratyphoid fevers, is perhaps one of the most important factors of spread. It is not, of course, possible to give statistics of this which could be regarded as scientifically accurate, but our observations upon the enormous numbers of intestinal infections which occurred in the Allied Armies at the time of the second battle of Château Thierry convinced us that the overwhelming majority of these cases followed the route of flies — food — fingers — mouth. In bacillary dysentery we think that perhaps this route is the most important of all by which the disease is conveyed.

The principles of prevention are easily stated. In most business organizations there is little or no refuse in which flies can breed, but in factories or other plants where waste accumulates which can lead to fly-breeding, arrangements must be made for prompt refuse disposal or treatment. This implies not only supervision of the factory grounds themselves, but stimulation of supervision of the neighborhood of the factory by the municipal authorities, since refuse in backyards adjacent to the plant can do quite as much harm in this respect as refuse in the plant itself. Access of flies to latrines is quite thoroughly prevented by proper plumbing, but routine inspection of all plumbing arrangements should be made to enforce the undelayed repair of leakages and the maintenance of cleanliness. The commitment of nuisances in or near the plant must be prevented, and kitchens and dining rooms, if conducted by the factory, must be screened against flies and kept fly-free.

We may summarize in saying that care of the water and milk, hand-washing, especially in relation to use of toilets and the taking of food, hygienic control of kitchen personnel, attention to towels, handkerchiefs and cleanliness of clothing, together with common sense in the supervision of fly-breeding and the access of flies

to latrines and kitchens should reduce intestinal diseases of every variety to a minimum.

Simple Diarrhea

The simple diarrheas occupy a position among the intestinal diseases somewhat analogous to that occupied by the common cold among respiratory diseases. Here, as in naso-pharyngeal catarrhs, it is likely that a large variety of causative factors can give rise to conditions which are clinically uniform except as to fluctuations in severity, owing to similarity of localization and of pathological processes. In both conditions, although the maladies are in themselves mild, their frequency and their tendency to predispose to more serious conditions render them important factors of economic disability.

The diarrheas which result from organic diseases of the heart, kidneys and stomach, and those incident to metabolic diseases or errors in diet are not of importance in connection with our present discussion, since they represent problems of individual medical practice and do not affect the community as a whole. Diarrhea is a sanitary problem only when it attacks a considerable number of people at the same time, and is, therefore, clearly due to a common cause.

Occurring in this epidemic form, diarrhea may be due either to the ingestion of specific pathogenic micro-organisms with the food, to toxic substances produced in the food by bacterial action before ingestion, or again to the ingestion of enormous numbers of ordinarily non-pathogenic organisms, which, because of their very numbers, set up abnormal putrefactive or fermentative processes of the intestinal contents.

Many organisms have been regarded as etiologically connected with simple diarrheas only because they have been found in preponderance in the dejecta of persons suffering from this condition. Such are the bacillus proteus vulgaris, streptococci and staphylococci, the colon bacilli themselves, the enterococcus (a capsulated streptococcus described by Besson and Thiercelin), the bacillus lactis aërogenes, as well as large numbers of other bacteria, many of which have practically no pathogenic significance under ordinary circumstances. It is quite likely that many of these bacteria may actually have caused the diarrheas from which they have been isolated, for it seems probable that almost any micro-organisms which can produce unusual food cleavages in the intestine may thereby indirectly give rise to irritation of the mucous membrane. It is not likely, however, that any of these can be regarded as specifically a causative agent in intestinal disease in the sense in which this conception applies to the typhoid and dysentery groups.

Much attention also has been given to various anaërobic organisms in this connection, more especially to those of the bacillus aërogenes capsulatus type. This bacillus, also spoken of as bacillus perfringens and the bacillus of Welch, was first associated with diarrhea in children by Klein (49). Much has been written on the subject since Klein's results were first published,* but doubt still exists concerning the direct etiological importance of the organisms. Simonds (50), who has recently made a thorough and extensive study of the problem, confirms the fact that this bacillus is a normal inhabitant of the intestines of adults. In the presence of an excess of carbohydrates in the intestinal contents, conditions may be brought about in the lower ileum which are conducive to the growth of the bacillus Welchii. The absence of lactic acid producing bacteria renders this condition still more favorable. Rapid increase of the organisms and the production of butyric acid with consequent diarrhea follows. It is not likely, therefore, that epidemic diarrheas will often be due to these bacilli.

The importance of the ingestion of massive numbers of foreign organisms of different varieties is emphasized by the studies on the simple diarrheas of children carried out in the New York Department of Health under the direction of Park and Holt (51). Their observations showed that disease incidence and death rate were always high when the milk was heavily contaminated. When raw milk containing from one million bacteria per cubic centimeter upward was fed, increase of diarrheal diseases resulted, even when the milk had been heated before feeding. This incidentally showed that the toxic products formed in the food before ingestion par-

* For a complete discussion of intestinal bacteria in this connection see also Herter's book, *The Common Bacterial Infections of the Digestive Tract*, The Macmillan Company, 1907, p. 40.

ticipated definitely in the production of diarrhea. Park's conclusions may best be given in his own words:

"The number of bacteria which may accumulate before milk becomes noticeably harmful to the average infant, in summer, differs with the nature of the bacteria present, and age of the milk, and the temperature at which it has been kept. When the milk is taken raw, the fewer the bacteria present the better are the results. Of the usual varieties, over one million bacteria per cubic centimeter are certainly deleterious to the average infant. However, many infants take such milk without apparently harmful results. Heat of 145°F. for thirty minutes, or of 170° F. for a shorter period, not only destroys most of the bacteria present, but, apparently, some of their poisonous products. No harm from the bacteria previously existing in recently heated milk was noticed in these observations unless they had amounted to many millions, but in such numbers they were decidedly deleterious."

And again:

"No special varieties of bacteria were found in unheated milk which seemed to have any special importance in relation to the summer diarrheas of children. A few cases of acute indigestion were seen immediately following the use of Pasteurized milk more than thirty-six hours old. Samples of such milk were found to contain more than 100,000,000 bacteria per cubic centimeter, mostly spore-bearing varieties. The deleterious effects, though striking, were neither serious nor lasting."

Intestinal irritations, therefore, resulting in diarrhea may be brought about by a large number of different bacteria whenever these bacteria are suitable in kind and sufficient in number to bring about massive abnormal fermentative and putrefactive changes in the food, either before ingestion or after gaining entrance to the bowel. Such conditions when they occur in epidemic form can usually be traced to food that has been unsuitably preserved, or handled in a grossly uncleanly manner.

In true dysentery epidemics, such as those that occurred in the armies during the war, the clinically characteristic cases have always been in the minority, and there regularly co-existed large numbers of mild intestinal disturbances in which nothing more was noticeable than a transient diarrhea and a little temperature. It is, of course, impossible to say that all these were true dysentery. It is even quite likely that the same defects of sanitary conditions which brought about the dysentery cases may have at the same time caused the milder infections. For sanitary purposes it is best to attempt diagnosis of the epidemic as a whole by isolating the more severe cases and carefully studying their stools, urines and bloods. If in these more severe cases true dysentery bacilli can be recovered, it is best to regard the entire epidemic as one of dysentery and act accordingly. A considerable number of clinically mild epidemics have been shown to be caused by bacilli of the para-dysentery groups, i. e., the Flexner-Manilla type, the Park-Mt. Desert type, and the Hiss-Russell Y bacillus. We ourselves have isolated this last organism from the stools of children, members of a group suffering from diarrhea which was not much more severe than an ordinary intestinal upset, and this epidemic could be traced to milk (52).

It must always be borne in mind that whenever one is dealing with a group of vaccinated individuals true infections with typhoid and paratyphoid organisms may be so modified by the previous vaccination that they may simulate simple protracted catarrh. In a paratyphoid "A" epidemic which we had occasion to study some years ago among troops just returned from the Mexican border, we saw a large number of true paratyphoid "A" cases in which the organisms could be recovered from the stools — cases which presented no symptoms further than slight rises of temperature and mild diarrhea.

Whenever, therefore, an epidemic of simple diarrhea cannot be easily and definitely traced to a dietetic cause, the severer cases should be selected for intensive observation, and careful bacteriological studies of feces, urine, and blood made. There is perhaps no problem of sanitation in which it is more important to exercise care in precautions and diagnosis than that which is involved in the management of an epidemic of simple diarrhea.

Meat Poisoning

The term "meat poisoning" is somewhat misleading owing to the fact that infections included under this name may be transmitted with foods other than meat. The contamination of other foods, however, is relatively infrequent, the great majority of such cases actually originating in meat.

There are two distinct varieties of meat poisoning. One of these is caused by a

specific infection of the meat with aërobic bacilli belonging to the paratyphoid " B " group; the other, known as " botulismus," is caused by an anaërobic Gram-positive bacillus which will be described below.

The earliest knowledge of bacterial meat poisoning dates back to 1888, when Gärtner (53) studied an outbreak of gastro-intestinal disease in fifty-seven persons who had eaten meat of a cow killed after veterinary condemnation. One of these patients died, and from the spleen Gärtner cultivated a Gram-negative organism which differed from the typhoid bacillus by fermenting dextrose with gas. The same organism was obtained from the suspected meat. His discovery was soon confirmed by numerous investigators, and subsequent studies have shown that the occurrence of this type of infection is by no means infrequent. Uhlenhuth and Hübener in the Kolle and Wassermann Handbuch (Second Edition, page 1039 *et seq.*) have tabulated a series of thirty-two outbreaks of meat infections in which bacilli of the Gärtner type were isolated. The most common sources of infection were beef, veal, and pork. Mutton and horse meat have occasionally given rise to the condition but relatively rarely. The disease is, of course, much more frequent than would be indicated by the tabulations of Uhlenhuth and Hübener since their report is limited to continental European outbreaks in which bacteriological proof has been brought. The majority of outbreaks of this kind would naturally escape the careful observation given to these selected epidemics.

The bacteria which cause these infections belong to the so-called paratyphoid " B " group which is composed of many types differentiable only by agglutination and other methods. Typical of the group are the Gärtner bacillus mentioned above, the bacillus Moorseele of Van Ermengem (54), and similar organisms isolated from cases. Closely related to them are the true paratyphoid " B " bacillus, the hog-cholera bacillus, the bacillus Typhi Murium, the bacillus Psittacosis which causes disease among birds, and the organism of Danysz (55) which is particularly pathogenic for rodents, and with which partially successful attempts have been made to exterminate rats and mice.

It is as yet questionable whether the organisms of this class found commonly in the intestinal tracts of domestic animals can in every case cause disease in human beings, and this point can be settled definitely only when distinct epidemiological data point to the origin of the infection in a particular animal. It is relatively easy to differentiate paratyphoid " A " from the organisms classified under group " B," but within this latter group accurate differentiation offers difficulties which up to the present time have not yet been fully overcome. All of these organisms are alike in morphology and show practically the same fermentation, while differing from each other in agglutination and other serum reactions. These serum reactions, however, indicate that the members of the group are all very closely related to each other.

The exact manner in which the infectious agent gains access to the meat is doubtful. Probably the bacilli pass out of the intestinal canal through the portal circulation just before or soon after death. In so many of the reported epidemics the meat was derived from animals killed because of veterinary condemnation, that it seems likely that there may have been a general infection before the animal was killed.

The types of disease which occur may take several forms. In some cases there is a clinical picture resembling moderately severe typhoid fever. In most cases of typical meat poisoning, however, gastro-intestinal symptoms occur within twenty-four to forty-eight hours after ingestion. Nausea, vomiting, abdominal pains, and severe diarrhea appear, accompanied by great weakness, headache, vertigo, and often pains in the extremities. The entire clinical picture points to disease of the gastro-intestinal tract, and when the cases are studied in relation to their recent histories, it will be found that a number of them have eaten of the same meat within the week preceding the onset of the attack. The diagnosis can be made with certainty only by isolation of the organism from the stools or urines of the patients or from the remains of the meat. Occasionally the bacilli have been found in the vomitus and in blood culture. Widal reactions are less helpful since they do not usually develop during the early acute stages when it is important to make a diagnosis.

Whenever an outbreak of acute gastro-intestinal disease with sudden onset, temperature, vomiting, and diarrhea occurs in a group of people, this disease should be

suspected and careful inquiry made into the individual histories of the patients. If a recent common meal is discovered, an attempt should be made to obtain some of the meat and other food taken during this meal, and a bacteriological study of this should be made. At the same time the various bacteriological examinations indicated above should be carried out on the patients. An epidemiological survey should always be made in order to trace the origin of the disease to a common meal, a restaurant or a mess, if possible.

Botulismus

True botulismus is a very much more serious disease than the preceding. It has been recognized as a clinical entity since the early part of the nineteenth century, and numerous outbreaks have been described since then. Mayer (56) published a report in 1913 which states that 800 cases have occurred in Europe since 1886, 200 of which have been fatal. A recent complete study of the disease is that made by Ernest C. Dickson (57), published in 1918. We refer the reader to this monograph for a more detailed account of the condition.

The disease may be conveyed by various kinds of meat, but especially by sausages and by canned meat, forms of food which offer ideal conditions for the development of anaërobic bacteria. Meat in general, however, may give rise to the disease, and even vegetable foods have been found responsible. Dickson mentions an outbreak which occurred in Darmstadt in 1904 in which home-canned white beans were the source of infection. Another occurred in Ontario, California, in 1907, in which the disease was traced to pork and beans. Canned pears gave rise to another outbreak and Dickson's own studies were based on a series of twelve cases occurring at Stanford University in 1914, in which home-canned beans were the source of infection.

The organism which causes botulismus was first described by Van Ermengem in 1894. It is a Gram-positive anaërobic bacillus, a spore former, which produces a powerful toxin during its growth in the food. This toxin is produced outside the body of the victim and is ingested, preformed, with the food. In his studies of the California outbreaks, Dickson isolated three strains of bacillus botulinus, the first of which was obtained from the gizzards of chickens fed on the suspected beans. Another he isolated directly from a can of string beans. His studies are especially valuable in that they point to the dangers which may attend the home canning of vegetables. This procedure is usually carried out without proper precautions by people ignorant of the dangers, and whenever diseases of the characteristics of botulismus occur in a community, investigation should not be restricted to the meat foods, but canned materials of all kinds should be included in the survey.

The disease itself is so characteristic that little difficulty should be experienced in recognizing it when it occurs in groups. The onset is usually prompt, occurring within twenty-four hours after the ingestion of the infected food. Not infrequently there may be a delay of two or three days. The earliest symptoms are usually weakness and fatigue, with headache and vertigo. Acute gastro-intestinal symptoms may be entirely lacking. Constipation is the rule. Early in the disease disturbances of vision may occur, which result from impairment of the muscles of the eyeball. The third cranial nerve is usually involved, with consequent blepharoptosis, mydriasis, impaired light reflex and diplopia. Photophobia is not uncommon. For a detailed discussion of the symptoms we refer the reader to Dickson's monograph. Complete paralysis of the pharyngeal muscles may occur and the voice becomes husky because of muscular impairment. Difficulties in swallowing and inability to chew ensue. The striking thing is the generalized muscular disturbance without sensory symptoms. One of the most characteristic diagnostic features is the absence of temperature. In the early stages there is neither fever nor is the pulse increased. In fatal cases, death occurs in from three to seven days and is due to cardiac or respiratory failure. Often there is a terminal asphyxia.

In discussing the diagnosis, Dickson states that the disease may be confused with poliomyelitis, cerebrospinal lues, bulbar paralysis, and poisoning with belladonna and methyl alcohol. The last named is a form of poisoning which must be frequently thought of in the immediate future, owing to the use of illegally marketed and home-brewed alcoholic drinks.

The mortality of botulismus varies considerably. In the Stanford cases 8.3 per

cent. only died, but in cases observed in the United States generally the mortality has been over 64 per cent. The diagnosis can be made with reasonable accuracy by careful clinical observation, and suspicion should be aroused by the occurrence of more than one case. Bacteriological studies may reveal the organisms in the infected food by anaërobic cultivation methods or, as in Dickson's experience, by feeding the food to chickens, observing their behavior and attempting isolations from their gizzards. A disease called limber-neck may develop in domestic fowl. This may occur at the same time that the human cases develop, and should always be investigated.

The antitoxin which has been produced with the toxin is of distinct value only when given prophylactically. Botulismus is best prevented by proper supervision of food. Especial attention should be given to canned foods, sausages, and other forms of animal and vegetable products which are preserved under conditions favoring anaërobic growth. Dickson advises that no home-canned foods should be taken under any circumstances unless cooked before eating.

Epidemic Sore Throat Due to Milk

For a great many years it has been realized in England that occasional epidemics of septic sore throat were traceable to milk, cream, ice-cream, etc. Swithinbank and Newman (58) in 1903 made a statement which we quote from Winslow (59), as follows: "It is safe to assume that a *year* never goes by in which there are no outbreaks of sore throat and tonsillitis due to milk and cream." A number of relatively extensive outbreaks are recorded in England from 1875 on, all of which show a fairly close parallelism in clinical symptoms and course. The onset is usually accompanied by a rather sudden chilliness or rigor, general muscular soreness, headache, and often nausea. Together with this, there is a sore throat which may be due simply to a severe general pharyngitis or may be more severe with swelling of the tonsils and cervical glands. Sometimes the cases may be followed by peritonsillar abscesses, and more remotely by joint pains and a typical rheumatic attack, occasionally developing into pneumonia. In this country an outbreak of considerable size, occurring in Boston and vicinity, was described in 1911 by Winslow who carefully studied the epidemiology of the disease, traced it with considerable definiteness to the milk supply of a certain dairy, and suggested the possibility of streptococcus as a causative agent. In the Boston epidemic there were forty-eight fatal cases. Since that time a considerable number of similar epidemics have been described in this country, one of the more careful studies being that of Capps and Miller (60) who observed an epidemic occurring in Chicago in December, 1911. In this epidemic it is alleged that as many as 10,000 people were affected, and of these hardly any came from the west side of the city. The relation to milk supply was carefully studied. Of 622 cases investigated 87 per cent., or 539, were users of milk from a certain Dairy X, and of 19 fatal cases 15, or 79 per cent., were users of the same milk. A comparison of the prevalence of sore throats in consumers of milk from this dairy as compared with the number of cases which appeared among those getting milk elsewhere, showed the morbidity ratio to be fourteen times as great among the former as compared with the latter. This was true of several districts in the city. Of 153 nurses in a certain hospital using this milk, 80 per cent. got the disease, while of 721 in another hospital, 4.8 per cent. came down with the disease. A coincident epidemic of sore throat was prevalent among the employees of the dairy, where bovine mastitis was found in the cows. In fact, 4.6 per cent. of the cows of this dairy had mastitis. Streptococci were isolated from the milk of a cow and from the throat of a girl on the same farm. The organisms isolated from throats and from cows were studied by Davis and Rosenow (61). In practically all cases they state that they found a streptococcus which grew well on the ordinary media, but on blood-agar plates produced colonies which were larger and more moist than are those of the ordinary hemolytic streptococcus. There was some hemolysis on such plates. The organism was virulent for guinea pigs, mice and rabbits, and developed a capsule after passage through animals.

It seems from this report as well as from subsequent ones that there is a definite streptococcus disease which can be transmitted from milk to large numbers of human beings and which may take its origin in the mastitis of cows. The number of

epidemics that have been described since then show that health officers confronted with epidemic sore throat should immediately suspect milk or cream. Recently there was brought to our attention by Colonel F. P. Reynolds an epidemic involving several hundred men at an army post in which hemolytic streptococci could be isolated from most of the throats examined, and in which the disease was confined to the mess which had eaten a certain shipment of ice cream.

In judging of such epidemics clinically it should be borne in mind that the onset of the disease, in so far as suddenness, the sore throat, the chilliness and pains in the muscles are concerned, is extremely similar to the onset of mild influenza, as encountered during the early epidemic periods, and careful bacteriological examination of the throats of such cases should be made. Our advice would be to make smears from the throat upon plates of blood agar and at the same time swab the throats into a mixture of broth and ascitic fluid, containing a few drops of blood to furnish hemoglobin. If such cultures are promptly incubated after inoculation, the presence of influenza bacilli or hemolytic streptococci would help solve the etiological problem.

The method of approach of a problem of this kind consists of, first, a rapid and careful epidemiological survey with attention to relation to milk, cream, etc.; the taking of fifty cultures on the early cases and, if the milk supply is found responsible, inspection of the cattle for mastitis, examination of the workers in the dairy for throat streptococci, and proper pasteurization of the milk.

Typhoid Fever

As stated in our general introduction, the spread of typhoid fever by water is rapidly decreasing owing to the attention given to water supplies by municipalities and state governments. There has been a notable drop of water-borne typhoid fever wherever properly supervised water filtration and chlorination have been introduced. The recognition of the importance of water in this respect has long been known, in fact, dates back to the first half of the nineteenth century, when water was recognized as a probable means of transmission for industrial diseases by Dupré (in 1823) and by Austin Flint in connection with an epidemic in North Boston, New York (1843). An historical summary of this subject has been compiled by Gay (47) in his book on typhoid fever. In the early epidemiology of typhoid fever, water was perhaps the most important factor. Schüder (62) in 1901 studied the literature concerning 650 typhoid epidemics, and comes to the conclusion that 62 were spread by water, 110 by milk, and 78 by all other means. These statistics, as well as studies of the numerical occurrence of typhoid fever in relation to the purification of water supply, have been entirely convincing in showing the importance of water-supply sanitation. Tabulation of the percentage diminution of cases upon the installation of proper water systems, as in Lawrence, Mass., Paterson, N. J., Albany, N. Y., etc., leave no room for doubt. Furthermore, the progressive decrease of typhoid fever in cities, as contrasted with country districts where individual water supplies for farm houses are still the rule, is another point emphasizing the importance of water. It has been shown that a marked decrease has occurred in city death rates from typhoid (from 20.6 to 14 per 100,000), while the rural mortality has remained practically stationary during the same period.

The importance of ice has perhaps been overestimated in the past, although it must not be overlooked entirely, and while the indirect conveyance of typhoid fever from water by the intermediation of oysters is a fact, it has numerically relatively small importance. In the sanitation of factory communities and similar small subgroups of the general population, preventive measures must focus upon direct and indirect contact infections which take their origins in unrecognized, mild cases (the types of typhoid and paratyphoid fever not infrequently observed in vaccinated individuals), in convalescents, and in carriers.

After the practice of vaccination becomes more general, as we trust it rapidly will, a considerable number of mild intestinal maladies, often taking the form of nothing more serious than mild diarrhea, will be shown to represent true typhoid and paratyphoid infections. We have had occasion, in the course of sanitary duty with troops returning from Mexico, to see large numbers of men who suffered from nothing more than mild fevers with recurrent diarrhea, from whose feces we could isolate paratyphoid bacilli; and during the second

battle of Château Thierry there were numerous intestinal infections among the vaccinated troops, which could be shown to be caused by these organisms, without presenting anything like the characteristic clinical features of true typhoid or paratyphoid fever. The actual typhoid-fever rate of the American Expeditionary Forces was amazingly small, but when the disease did appear in moderate numbers in some of the divisions previously exposed to the wretched sanitary conditions incident to prolonged battles, it was found that a considerable number of carriers of typhoid and paratyphoid bacilli had developed, most of whom gave histories of mild diarrheas and fevers, variously diagnosed at the time of their occurrence as intestinal "flu" or simple diarrhea. Study of the kitchen personnel of one such division showed not only carriers in a large number of the kitchens, but revealed that 17 per cent. of the cooks of the division had recently had or were then having mild diarrheal attacks, some with slight fever. When, as it will increasingly happen in the future, many members of factory or other communities have been vaccinated, strict bacteriological attention must be paid to all cases with suspicious intestinal symptoms and mild fever. By this it is very likely that numerous, otherwise undetected potential sources of typhoid distribution can be eliminated, and such persons must of course be subjected to the same vigilance with which today all well-trained physicians surround their typhoid cases.

Precautions to be taken in the care of typhoid patients for the prevention of spread of the disease are too well understood to call for discussion. Every physician knows that in such cases the dejecta and the urine must be sterilized, that bed linen, eating utensils, in fact, everything that has been in contact with the patient should be carefully handled and disinfected, and that nurses, doctors, and other attendants must pay strict attention to cleanliness of hands. In all well-regulated hospitals, moreover, the discharge of convalescents is delayed until several negative urine and stool cultures have been obtained. These are matters of hospital and sickroom discipline, about which we need say very little.

The protection of the community against the sick, however, even though some of these cases are difficult to recognize, is a relatively simple problem provided physicians are well informed and alert. More important from a sanitary point of view and much more difficult of management is the carrier problem. In the case of typhoid fever, a scientific conception of the importance of carriers dates back to 1902, when Koch (63) noted the frequency with which typhoid fever originates in this way. Since then a large literature on the subject has accumulated, and our knowledge of carriers in general has been very much extended. A summary of the problem was made by Sacquépée (64) in 1910, and the subject has again been recently reviewed in Gay's book on typhoid fever.

Sacquépée classifies typhoid carriers into:

A. Healthy carriers who have never had typhoid fever, at least as far as can be ascertained from the history.
B. "Precocious" carriers who begin to excrete typhoid bacilli during the incubation time.
C. Post-typhoid carriers.

Under the heading of post-typhoid carriers we can consider:

I. Convalescents who get rid of the bacilli within about three months.
II. Chronic carriers who continue to eliminate typhoid bacilli for many years.

In the course of convalescence from typhoid fever the bacilli are excreted with the urine and feces, where they appear very shortly after the beginning of the disease. It is probable that the organisms not only get into the feces directly from their original points of lodgment in the intestine but, in addition to this, the gall-bladder is infected very shortly after the bacilli get into the general blood stream. From the gall-bladder then, they are returned to the bowel, whence they appear in the feces. During the disease and in early stages of convalescence both the urine and the feces are of perhaps equal importance, and during convalescence the urine is a greater menace to the public, owing to the more indiscriminate distribution of urine. It is relatively rare, however, for the organisms to persist for any considerable length of time in the urine. They usually disappear from the urine within the first few months following recovery, and Prigge (65) (as quoted by Gay) found only 7 per cent. of 340 carriers examined to be of the pure urinary type. A few of these gave no history of typhoid fever. Occasional cases of

urinary-carrier state, however, persist for many years. Such are the cases reported by Gwynn who discovered a urinary carrier five years after recovery, and attributed the persistence of the organisms in the urine to chronic cystitis. Irwin and Houston (66) describe a urinary carrier who continued for seven years after the disease, and had given typhoid fever to a number of persons. An interesting case operated upon by Mayer and Ahremer (67) had been a urinary carrier for ten years owing to a pyonephrosis caused by the typhoid bacillus. These facts are cited only to emphasize the fact that chronic urinary carriers must be borne in mind by those faced with epidemiological problems, and that such urinary-carrier states are usually associated with disease of the urogenital tract.

Far more important than the urinary carrier, however, is the fecal carrier. Sacquépée speaks of "chronic" carriers when the organisms persist for more than three months after convalescence. Up to three months after cure from the disease, the condition seems in most cases to be a transitory one which is likely to disappear spontaneously in the course of complete return to health. After this period there seems to be no possible way of foretelling how long the condition may last. We have isolated typhoid bacilli from the gall-bladder seventeen years after the patient has had typhoid, and other instances are on record in which the carrier condition has lasted for forty-six and fifty-two years respectively. In such cases the organisms are nested in the gall-bladder. Here they can remain indefinitely, being discharged, either steadily or intermittently, into the bowel whence they are voided with the feces. In the gall-bladder they frequently set up chronic inflammatory conditions as a consequence of which gall-stones may form. Indeed, it is not impossible that a very large percentage of cholecystitis cases have their origin in typhoid fever, though of course it would be unreasonable to suppose that no other organisms could set up a similar inflammation.

The frequency of carriers has been made the subject of special studies by many workers. Percentage estimates determined by different investigators naturally show considerable variations because of differences in technique and in the types of individuals examined. Gay has made a tabulation of some of the work done on this subject, and concludes from these figures that about 4 to 5 per cent. of all recovered cases become chronic carriers. This seems a rather likely figure which, if it errs at all, does so on the conservative side. For we must remember that experimental findings must always fall short of the truth, owing to difficulties of technique, the intermittent nature of bacillus excretion, and because of the small numbers of bacilli likely to be present in many chronic carriers. Astonishingly high percentages have been found by Semple and Greig (68) who worked in India and carried out repeated examinations of individual stools. These workers reported 11.6 per cent. chronic carriers in the cases they examined. If one accepts the conservative estimates suggested above as a probable average, that is 4 to 5 per cent. of all recovered cases, it becomes plain that every year a large number of typhoid carriers are added to the population, and that consequently the foci for possible distribution of the disease must rapidly increase. On this basis, the total number of carriers in the general population represents a not inconsiderable percentage.

Attempts to estimate the number of carriers of the general population, irrespective of whether they have had the disease or not, have yielded various figures. Prigge, examining 10,841 individuals of the general population of Saarbrücken, reported 0.29 per cent. carriers; and similar statistics made on 20,019 people by Müller (69) yielded 0.8 per cent. carriers. From a study of available statistics it would seem that one might safely assume anywhere from three to five carriers for every thousand people. This of course means that there must be many carriers who never have had typhoid fever, and these are the ones which Sacquépée calls "healthy carriers." It is of course impossible to refute with certainty the contentions of Lentz that these "healthy carriers" are people who have actually had a mild and unrecognized typhoid or paratyphoid infection. However, there are undeniable cases in which absolutely no history of the disease can be obtained. Scheller (70), Klinger (71), and others, indeed, claim to have observed cases in which the typhoid bacillus has lodged in the gall-bladder, leading a saprophytic existence there without ever inciting symptoms of disease. Scheller

reports an epidemic in which a woman who was a chronic carrier contaminated the milk of a dairy — milk which had been drunk by forty people. Among these there were seventeen who remained perfectly healthy, but showed typhoid bacilli in the feces. When the woman was removed from the dairy the bacilli disappeared from the milk. Such cases, called "ephemeral" carriers by Sacquépée, may carry the bacilli for a short time only. Sacquépée states that one may frequently find such carriers in the environment of the sick.

Progressive elimination of water-borne typhoid fever in cities, and better hospital care and sickroom supervision of typhoid cases are removing these sources of transmission. The carrier problem, however, has been less amenable to sanitary measures, and is consequently becoming the most frequent source of epidemics. Direct contamination from a carrier is relatively infrequent. The danger lies more particularly in the contamination of food by carriers who are associated with work in dairies or kitchens or who are handling food for others in some other capacity. Kayser (72), who has paid particular attention to milk infections, studied the probable origin of 260 cases of typhoid fever which occurred during 1904 and 1905. Sixty of these he could associate directly with raw milk. Studying only the 126 cases that occurred in 1905, 40 per cent. of these had probably acquired infection from milk, and milk is easily contaminated by the hands of carriers who are doing dairy work. The relative importance of milk in the general incidence of typhoid fever has been mentioned in connection with the statistics of Schüder (62), which have been cited in a preceding paragraph. As to the importance of other food, Brückner (73) thought he was able to trace fourteen out of twenty outbreaks in a single town to contamination of various kinds of food. Higher estimates than these have been made by Garbat (74) who believes that 50 per cent. of endemic typhoid fever is due to carriers. And in outbreaks that occur in armies under modern military conditions, we believe that almost all of the cases originate in carriers.

What has been said about typhoid fever applies equally to the paratyphoid fevers. Fewer systematic investigations have been made in these fevers, but experience is showing what might have been expected, namely, that exactly the same principles apply to these diseases that are found to govern the spread of typhoid fever proper. We have frequently been able to trace typhoid and paratyphoid fever to tent mates, and especially to cooks who were typhoid and paratyphoid carriers; and, as mentioned before, the frequency with which unavoidably poor sanitation is associated with battle conditions brings about a generalization of intestinal infection which leads to the development of many new carriers who have either escaped illness entirely, or have had the disease in a mild form, owing to modification by recent vaccination.

It becomes plain from these considerations that in a factory or another industrial community the danger of typhoid and allied fevers lies chiefly in the carrier. Here, more than in any other form of disease, the sanitary supervisor of the factory personnel should look upon himself as an integral part of the community as a whole. He should intelligently inform himself of the efficiency of local water-supply control. He should keep in touch with dairy supervision in the neighborhood, or at least be ready to look into this matter if suspicion points in this direction. If the plant is running a restaurant or kitchen for the workers, he should know the typhoid and paratyphoid-fever history of everyone working in the kitchen, and if laboratory facilities are available (and they can always be made available by utilizing municipal laboratories) repeated carrier examinations should be made upon all kitchen workers and food handlers. The general precaution of hand washing after defecation and before meals has been considered above.

When a case of typhoid fever occurs, a rapid survey should be made. Perfect isolation of the case must be enforced immediately. Next, the general water supply should be re-examined and the sources of water supply in the homes of workers investigated. Inquiries concerning the sources of milk supply and the habits of milk drinking should be made. A re-examination of kitchen personnel in the factory should be instituted, and, if there is no kitchen personnel, a carrier examination of the patient's own family should be urged upon them and carried out if consent is given. Should several cases occur in the same plant, an epidemiological study of the movements of individuals will often lead to

a common source. It may become necessary to carry out an extensive survey for carriers in the plant, a task which, with modern laboratory facilities, is not difficult.

It should be relatively easy for a properly trained sanitary inspector to run down the origin of typhoid cases with considerable accuracy in most instances, and even though the exact carrier in all cases may not be traceable, it is always possible by general sanitary measures to break the circuit of transmission in the case of emergency and prevent the development of any large number of cases.

However perfectly general sanitary measures may be carried out, it is likely that it will never be possible to suppress completely the enteric fevers by this means alone. Fortunately, however, we are in possession of still another weapon against these diseases which would probably prevent them entirely if systematically and universally applied, namely, vaccination. Any doubt which may have existed about this before the war has vanished in the face of results obtained by vaccination in the Allied Armies. The statistics of typhoid fever in the American Expeditionary Forces show a negligible percentage of cases. There were practically no cases in the early months of the European activities of the Army, and the cases which occurred later, after the troops had been subjected to battle conditions, were amazingly few compared with any previous record. Statistics have not yet been published, and we cannot quote them with percentage accuracy. They were certainly small and, from personal experience, we can vouch for the fact that they were not small because of the perfection of other sanitary safe-guards. There were many occasions, such as the second battle of Château Thierry and the battle in the Argonne in which sanitary arrangements were, perforce, sacrificed to the pressure of grave military necessity, and we are convinced that, had it not been for vaccination, an enormous amount of typhoid fever would inevitably have occurred. In the Army in the United States it is not unlikely that general sanitary measures played a definite part in the reduction of typhoid, since the troops in cantonments were protected from infection by water and food, and were supervised carefully in regard to cleanliness, latrines, flies, and kitchens. Nevertheless, such studies as those on communicable diseases in the Army of the United States by Vaughan and Palmer show that, while sanitation reduced the intestinal diseases considerably, it was vaccination which brought them down to practically nothing. There were twelve camps in the United States without a single case of typhoid or paratyphoid fever, and Vaughan states that "the army camp is a safer place to dwell, as far as typhoid fever is concerned, than the most favorably situated civilian community." There can remain little doubt that typhoid fever can be almost completely eradicated if vaccination can be introduced into civilian communities on a large scale. Sanitation can probably do 80 per cent. of this suppression. But, as we have seen, there will always remain a slight sporadic incidence due to carriers and unrecognized cases, and these cannot be completely guarded against by sanitary measures alone. A part of the educational work of the industrial sanitarian should consist in urging typhoid vaccination upon his community. Concerning the type of vaccine to be used, there is still some controversy. Some form of lipo vaccine may eventually prevail, but this calls for further investigation. For the present we should advise the administration of the saline suspensions of killed typhoid bacilli, administered in three injections, precisely as practiced with such splendid results in the United States Army.

Paratyphoid Fever

In regard to paratyphoid fever, it does not seem that anything more need be said. There is no reason to believe at the present time that there are any differences, either in the principles of transmission or in the fundamental measures to be used for prevention, between typhoid fever and the paratyphoid diseases.

Bacillary Dysentery

In dysentery, also, much that has been said about typhoid fever applies. However, while water and food may play a definite part in the spread of bacillary dysentery, it is probable that the route—feces, flies, food, mouth—is relatively more important in dysentery than are some of the other routes considered in connection with typhoid fever. This was certainly apparent in all armies that had dysentery

during the war, and it is likely that a great many of the very mild diarrheas which were noticed during the war were true bacillary dysentery. That true bacillary dysentery can appear in the summer time as a simple diarrhea and will, therefore, attract little serious attention from the sanitarian has been shown by Wollstein, La Fetra, and Howland, Flexner, and others. As in typhoid fever, there are chronic dysentery carriers. Many such have been described by Lentz, Kruse, Mayer, Simons and others. These may, as in the other diseases mentioned, be convalescent, chronic, or even healthy carriers. Thirteen such healthy carriers are described by Simons in connection with an epidemic at Hagenau. We ourselves have described a dysentery epidemic during the winter months in a children's hospital, which was indirectly traceable to milk, and perhaps originated in a carrier. In a general way, therefore, a true understanding of the conditions underlying typhoid fever will be equally applicable to bacillary dysentery, and the measures applicable to the prevention of one of these diseases will cover the others.

It does not seem to us, however, desirable to attempt dysentery vaccination in civilian communities since, in the first place, its efficacy is as yet uncertain, and the relative infrequency and mildness of the disease in this country do not seem to us to call for procedure at the present time.

In the foregoing outline of sanitary principles and procedure no attempt has been made to cover the entire field of communicable diseases. We have omitted such important conditions as smallpox, scarlet fever, poliomyelitis, malaria, etc., and other acute diseases, as well as the important chronic infections, tuberculosis and syphilis. To cover the entire field accurately would have needlessly prolonged the paper, and would not have added materially to its value as a guide to procedure or elucidation of fundamental principles. In the case of the chronic infections mentioned, the problem of community control is becoming more definitely a sociological rather than a purely sanitary problem, and these conditions should, therefore, be treated separately.

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CHRONIC BENZOL POISONING *

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In January, 1918, two cases of purpura hemorrhagica were brought to the notice of the Factory Department by Dr. Veitch of Edinburgh. The illness affected two men employed in a large rubber works as rubber spreaders; one case was reported as already having proved fatal; the other, as being seriously ill in hospital. These are the first cases of chronic benzol poisoning known to have occurred in this country.

Cases of chronic benzol poisoning have been reported from time to time from other countries. In 1911 two fatal cases in rubber works (characterised by purpura hemorrhagica) were reported from Austria (1). Santesson (2) reported in 1897 four fatal cases occurring among nine women engaged in a tire factory in Sweden. The prominent symptoms of these cases were purpuric spots (*i. e.* hemorrhages into the skin) and hemorrhage from the nose and mouth. Three similar cases were also reported by Selling (3) in 1910 in an American cannery among girls employed using a solution of rubber and benzol for sealing tins. In all the cases in which blood counts were made a great diminution was observed in the number of red blood cells which, in one case, fell to 640,000 per c. mm., together with marked leucopenia (diminution in the number of white blood corpuscles), the loss chiefly affecting the polymorphonuclears (special form of white blood cells).

Investigation by Dr. Bridge of the cases reported by Dr. Veitch showed that the two men were employed in rubber works spreading balloon fabric. In September, 1917, they had been transferred to a new spreading room accommodating twenty spreading machines. Three machines were used for spreading the balloon fabric, the rubber for this being dissolved in benzene (crystallisable benzol); the solvent previously used having been coal tar naphtha. The two men concerned were working on two of the three machines. The first man left work on Dec. 11, 1917, and died on the 18th, the second gave up work on Dec. 13, 1917, and died on Jan. 9, 1918. Approximately, therefore, three months elapsed between the commencement of intoxication and the onset of acute symptoms. The ages of the two men were 30 and 29 years and both were apparently healthy young men. As Dr. Veitch stated "both were young men, both were changed from one room to another, both were changed from one drug to another, and both developed the same symptoms at the same time." The history of these cases was practically identical, commencing with malaise and anemia which was followed by subcutaneous and submucous hemorrhages, and both were eventually admitted to hospital suffering from bleeding from the nose, gums and bowels. The blood count of the first case, under the care of Professor Gulland of Edinburgh, was as follows: — Red blood cells, 2,800,000 per c.mm.; white cells, 2,000 per c.mm.; hemoglobin, 35; color index, 0.6.

The chief characteristic of the postmortem examination in both cases was numerous submucous hemorrhages throughout the intestinal tract and under the endothelium of the heart. In the second case, where a more detailed examination was available, characteristic changes were observed in the bone marrow of the long bones. The conditions observed in life and after death were those seen in cases of aplastic anemia and are identical with those which have been noted in twelve cases (all fatal) arising from poisoning by T.N.T.

A third case was reported in July, 1918, and also proved fatal; the patient was one of three men employed in coating metal rims with rubber solution in the manufacture of pneumatic tires. The use of benzene as a solvent commenced in January, 1918, and a description of the working conditions found is worth stating as it shows the adverse effect produced by accidentally diminishing ventilation where fumes from benzene or other similar bodies are given off during work. The workroom

* Reprinted from the Annual Report of the Chief Inspector of Factories and Workshops, Great Britain, for the Year 1918.

was the corner of a large spreading room partitioned off partly with glass and partly with wood. The dimensions were: — 12 feet long, 12 feet wide, and 11 feet high; there were six windows made to open, four being placed on one side and two at one end. The area of each when fully open was 28 by 36 inches.

At the beginning of May, 1918, structural alterations were commenced on the floor above and, in order to support the framework of the windows, wooden uprights were inserted in the window-frames. This prevented four of the windows opening beyond a few inches, so that from May onwards ventilation was only provided by means of two windows. The man who died was one of three men employed in this room; he was 33 years of age, and presented the same symptoms as those recorded above.

Although in both instances medical examination was immediately made of all the other workers exposed to benzol, no other worker showed any signs of poisoning.

The firm's chemist made determinations of the amount of benzol in parts per 10,000 of air at different places in the spreading room.

Sample From	No. of Machines Spreading when Sample Was Taken	Benzene in Parts per 10,000 of Air
Middle of corridor opposite a machine	7	2.1
In front of a fan and at back of machine, machines on both sides, both spreading	8	10.5
Between two adjoining machines, both spreading, 1 ft. from floor . . .	6	3.7
Between two adjoining machines, both spreading, close to ceiling . . .	6	4.6
1 ft. from gauge of a machine at level of spreader's face	5	2.5
1 ft. from gauge of a machine where boy takes up cloth	10	2.5
During spreading of varnish coat . . .	8	8
During spreading of varnish coat . . .	5	7
During spreading of body gum . .	3	4
Dough mills at height of worker's face	—	6

From these data Mr. Stevenson Taylor calculated that in a spreading room with a capacity of 55,000 cubic feet and containing 10 spreading tables for proofing balloon fabric, 15.33 cubic feet of benzol vapor will be produced per minute. Hence, with 30 changes of air per hour, assuming uniform diffusion of the vapor, the atmosphere in the room would contain .055 per cent. (*i. e.*, 5.5 parts in 10,000) by volume of the vapor. This amount is well below the lower explosive limit for mixtures of benzol vapor and air, which is 3 parts of benzol vapor and 97 parts of air, the upper explosive limit being 6 parts of benzol vapor and 94 parts of air. If the same room were unventilated, at the end of an hour the atmosphere in it would contain 1.68 per cent. (*i. e.*, 168 parts in 10,000).

In view of the dangers disclosed, the alternatives were either to stop the use of benzol or to increase the ventilation of the rooms in which it was to be used so as to reduce the percentage of benzol in the air below a toxic limit. The experience gained in the ventilation of dope rooms encouraged belief that the same method of dealing with rooms in which benzol was being used would prove effective, and it was on these lines the Factory Department proceeded. The ventilation in the spreading room where the two fatal cases occurred was immediately taken in hand and was improved so that the number of changes of air per hour was increased from sixteen to fifty-seven. Immediate steps were taken to protect the workers on tire manufacture and the work was transferred to a room efficiently ventilated. Subsequently in the pneumatic tire room, a fan displacing 4,370 cubic feet of air per minute was installed, and a sample of air tested with the windows open but with the fan stopped showed 28 parts of benzol per 10,000 of air while, with the fan running, a sample taken as near as 18 inches from the work performed showed only 8 parts. The result in both cases was satisfactory in that no further cases occurred.

Medical supervision of the workers was also immediately instituted and all firms likely to be engaged on this class of work were visited and instructed as to the precautions they should take in the event of benzol being used.

Dr. J. Burnet, the Certifying Surgeon for Edinburgh East, who carried out the periodic medical examinations of these workers, regards hemorrhages from the mucous membrane of the gums and nose as an early symptom and one that can be safely used as a guide for the purpose of exclusion from work (4).

Alternatives to benzol were also considered. Inquiry was kindly undertaken on this point by Dr. H. H. Dale, F.R.S., and Miss F. M. Durham of the Medical

Research Committee into the toxicity of a mixture known technically as "Xylol compound," which was capable of being supplied in large quantities by the Asiatic Petroleum Company. The point referred was whether it could be used safely as a rubber solvent. Dr. Dale reported that "from the practical point of view, it seems that the Xylol compound could be used as a rubber solvent with, at any rate, very much less danger of causing aplastic anemia and purpura than benzene."

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NOTE ON ANTHRAX IN KASHMIR

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ANTHRAX is one of the dangerous occupational diseases to which man is liable. Sporadic cases will assuredly crop up in different countries of the world unless it is stamped out at its original sources.

Ernest F. Neve in an article on *Cutaneous Anthrax* (British Medical Journal, 1919, Vol. II, page 559) says, "it is extremely common in animals in Kashmir. Every few years an epidemic sweeps through the valley carrying off thousands." Since 1900, seventy-five men have been treated by him at the Kashmir Mission Hospital for cutaneous anthrax, and he finds the disease is becoming more frequent. So far as Neve knows, the hides of animals are exported without warning or precautions. Of his cases, 40 per cent. were affected in the upper extremities, 32 per cent. in the head and neck, and 12 per cent. in the back. In the hide and skin industry, out of 923 cases investigated by W. Koch, the head and face were primarily affected in 48 per cent., and the upper extremities in 40 per cent. Legge finds, in the heavy woolen industry, the incidence to be head and face 45 per cent., neck 41 per cent., and upper extremity 12 per cent. Neve, in his article, utters the serious plaint "that the prophylactic serum which is procurable at the Imperial Bacteriological Laboratory, Muktesar, has not yet been brought into use." Only seven died out of his series of seventy-five cases. His only treatment was a very thorough cauterization with a red-hot button cautery.

UNNECESSARY FATIGUE — A MULTI-BILLION ENEMY TO AMERICA *

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AND

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Unnecessary fatigue is one of the greatest of wastes. We believe that a conservative estimate of the loss to our nation in productivity alone is *more than* 20 cents per worker for each and every working day. We have arrived at this estimate after many years of intensive study of this subject, in connection with our work as consulting production engineers in this country and in Europe.

There are more than 300 working days in each year, and the United States census shows more than 35,000,000 workers in this country, the output of a large majority of whom is undoubtedly affected by unnecessary fatigue. An instant's figuring shows that unnecessary fatigue, therefore, causes a loss in production that is colossal. This loss is much larger than the total fire loss, and the preventable fire loss alone is shocking. This tremendous loss from fatigue is not for one year only. It is year after year; it is continuous.†

An astounding loss in production is by no means the total loss which is chargeable to unnecessary fatigue. There is also the loss in materials that are spoiled and in overhead charges caused by the unnecessarily fatigued worker. Again, there is loss due to absences caused by accident and sickness which are often the indirect results of unnecessary fatigue. Statistics show that the over-tired workers are the ones oftenest injured and oftenest absent. There is also the loss due to the lack of co-operation that comes as a result of the discontent due to over-fatigue, and the resentment due to a belief that the management has not done all it could to provide for the workers' relief from unnecessary fatigue. These losses are real and tremendous, though to some they may seem intangible.

To those who have not considered the astounding costs to our nation by reason of unnecessary fatigue, or who do not believe that their own particular organization is paying heavily for not eliminating such fatigue, we recommend the making of a regular fatigue survey of their own conditions. We have found that such a survey will pay in an organization, large or small. It will pay when there are 10,000 employees and it will also pay in the smallest of organizations, even in one's household. We have found it to pay large dividends in the one, and to aid in solving the help problem in the other.

Another feature that should be brought out in connection with the problem of eliminating unnecessary fatigue is that all countries are now beset with labor troubles. The cost of living and the amount of wages are traveling upward in an endless spiral, and raises of pay, although large beyond precedent, are not satisfying to the worker because their purchasing power is not simultaneously raised. Too many of our population have not the slightest conception that there is such a thing as an actual science of economics, and many of them who have, have no true conception of its principles. This statement does not refer exclusively to those of little schooling. There are many so-called "highly educated" people who are still clinging strenuously to false conceptions and theories abandoned long ago by practical economists. The day when the majority of the voters will be prepared by education to vote correctly on the great economic questions is in the far distant future. Nevertheless there are certain fundamental principles that could be taught in all schools, even in the primary schools.

For example, it should be realized that *a person's true purchasing power is his producing power*. It should be realized that the greater the production the greater the prosperity. It should be realized that any kind of waste cuts down the producing power and, therefore, the earning power. These are most elementary and fundamental principles. It would seem that

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† See *Industrial Fatigue in its Relation to Maximum Output* by Prof. Henry J. Spooner, C.E., F.G.S., published by George Routledge & Sons Ltd., 68 Carter Lane, E.C., London.

they are obvious, but on the contrary they are, to a large portion of our population, by no means obvious. There are hundreds of thousands of people today advocating the reduction of individual outputs as the only cure for all industrial ills.

Now of all wastes and of all hindrances to production, unnecessary fatigue is the most senseless. It does no one any good. Its elimination is a problem in which everyone can share, and all can share also in the benefits derived from this elimination. It is a subject of prime importance because the interests of the employers, of the workers, and of the public are identical, and therefore co-operating on fatigue elimination will foster better industrial relations. Let us not, moreover, postpone the beginning of this campaign for the elimination of unnecessary fatigue until the division of the profits resulting from it has been determined and agreed upon. The savage Indians knew better than to postpone the accumulation of the spoils until after the arrangement of division was determined. Let the accumulation of the spoils begin at once!

Now how can this campaign be started, and when can it be made? We urge that the first Monday in December each year be recognized as the day on which all organizations take up the subject at meetings of foremen and others, and that the work of other organizations be exchanged and studied. Most satisfactory work has already been done along this line by Professor George Blessing of Swarthmore College.

We have found that the first and logical place to start is with a fatigue survey. The more systematically this is undertaken and the more carefully it is made, the better, but the roughest and most casual survey will instantly reveal opportunities which will more than repay the cost and which will satisfy any religious yearnings on the part of the executive or employer to comply more nearly with the golden rule. As a matter of fact, the golden rule as a method of attack in fatigue study as well as a law of management has never been excelled. The lack of interest in the past in the fatigue of the workers would justify the old saying, "Man's inhumanity to man makes countless thousands mourn," and inspire a new saying, "Executives' lack of knowledge of the least fatiguing way to make large quantities of production makes countless stockholders kick." This may be the viewpoint necessary to arouse the indifferent manager and add an interested to the disinterested motive.

In the fatigue survey perhaps the most important data are those which have to do with lighting, including glare and reflection, and with alternate sitting and standing. There is no excuse today for insufficient lighting or for poorly distributed lighting. Information regarding the good work done by Professors Scott and Clewell and others on efficient lighting is now available, and the shadows and glare from improperly arranged artificial lighting are no longer necessary.

The factory with the machines painted black, the dark dadoes, the "neutral-tinted" walls, the piping systems painted distinguishing colors all over instead of at their fittings only, would be ridiculous if they were not so pathetic. All surfaces of all factory workrooms should be painted white. There should be a national law that all enclosed stairways should be painted completely white on the entire ceiling and down to the floor. The whiter the stairway, the more light and the easier for the tired worker to see his way and avoid accidents. More people are killed yearly in the United States by falling down stairs than are killed on the railroads, and the majority of these accidents are avoidable with slight cost and effort. All closets and all lavatories should be painted white.

Walls that are painted a dark color from the floor to a height of from 4 to 6 feet can be found in the majority of factories at the present time. This is for the purpose of hiding the dirt. It is the old plan of putting on powder instead of washing the face. The dirt is there just the same but it is argued, "You can't see it, and it looks nicer." To keep a thing clean, paint it white. Dirt that shows on the walls and on the machines is seldom of importance compared with the benefits of more light in a factory, and the workers are always more careful when the dirt shows. The same thing applies to machines. Our records show that workers keep machines in better condition when they are painted white and when all dirt is thus made to show. White machines result in less spoilage. The whole tone of workmanship is better when machines are painted white, even when they get daubed with oil and grease.

The present lack of knowledge regarding proper painting often leads to amusing re-

sults. We had one client who had painted all interior surfaces of his entire plant the color of pea soup because an artist friend said that that color "was most restful." In his desire to serve his employees our client made the order to paint most emphatic, and the darkest rooms in the cellar were, as a result, also painted pea green. It is needless to say that they are now being gradually changed to white.

We have carried on some research and studies in our laboratories on finger keystroke machines, in speed contest work, and in methods of least fatigue, with most interesting results. They illustrate another reason for painting all walls and surfaces and machines white, wherever possible. The depth of focus of the eye is almost exactly inversely proportional to the diameter of the pupil of the eye, and the diameter of the pupil of the eye varies inversely with the lighting. Now the greater the depth of the focus, the less the muscles must adjust the convexity of the lens of the eye. The possibilities of the elimination of the eye fatigue, which means general fatigue, is rarely realized, and the simple devices that are now available for measuring actual lighting results are unknown to most executives and workers.

Chairs share with lighting the most important place in the problem of eliminating unnecessary fatigue. Any kind of chair, stool, box or rail to sit on is better than nothing. If one must decide between a poor seat and no seat, the poor seat is usually much less fatiguing. Many kinds of work, which do not seem to lend themselves to being performed while sitting, can be efficiently performed sitting simply by having a chair specially made or altered to suit the individual case. For examples of such chairs, see *Fatigue Study* (The Macmillan Co., 64 Fifth Ave., New York City). Many kinds of work that apparently cannot be performed while sitting have occasional periods of unavoidable delay during which a worker could rest, if he were provided with a chair available at all times. Sitting down at least a minute or two each half hour while working makes a big difference in the total fatigue of the day's work as compared with not sitting at all.

Expert salesmen all agree that the seated salesgirl is psychologically handicapped in making sales, and that, in order to sell to the average female customer, she should be in the attitude and posture of the standing server, delighted to serve regardless of self-comfort. A slogan, "Buy of the seated salesgirl," would help this condition.

At almost no cost, factory workers can have their workplaces and chairs designed or altered for their individual measurements, and in the majority of cases should have tables or benches made for working at standing height, and chairs arranged to maintain the elbows the same height above the floor while either sitting or standing. This is not intended to convey the idea of sanction or approval of the too common bookkeeper's chair, with its inhuman round top and its opportunity for the bookkeeper to imitate a woodbine around and through its legs and rungs. Such chairs were made to satisfy the requirements of a manager of sales of some great furniture concern who did not care what was done with them after the typical purchaser had been convinced that the original price was not high compared with their durability. Such chairs are generally too durable. The average chairs of offices and factories are like the traditional definition of a coffin: "The man who made it doesn't want it, the man who bought it didn't use it, and the man who used it didn't have much to say about it."

Workers generally have not until recently entered into the fatigue-elimination campaign as heartily as we had hoped and expected. At first we were puzzled, but soon realized that some of the young workers had not so much need of the anti-fatigue devices, and that the strenuousness of youth, of course, set the fashion. The older employees naturally did not care to emphasize their excess fatigue. But when the graphical record shows the difference in production, it puts the matter on a sound footing of economics, as well as of comfort and satisfaction, and now we are getting co-operation and intelligent help from the workers.

Proper eye-glasses will eliminate much unnecessary eye fatigue. Probably no factory can afford not to have available for its workers the services of a skilled oculist. The number of workers who need eye-glasses or who have improper glasses is much greater than is usually realized. We know of cases where vigorous workers in the neighborhood of 45 to 50 years of age have been apparently tired out every day at quitting time, workers whose earnings dropped off without apparent reason, in some cases as

much as 20 per cent., and yet these same workers later exceeded their best records of production after being properly fitted with glasses.

One of the most ridiculous features of our fatigue-elimination campaign is "the female of the species" who becomes thoroughly convinced of the general principles of the plan, and who becomes most enthusiastic to help in the campaign for the elimination of all unnecessary fatigue, and who then comes to work wearing the most pointed toed and the highest of high-heeled shoes procurable. This person ranges from the college post-graduate, private secretary type, to the tuberculous, underpaid, undernourished factory girl from a poverty stricken family.

High heels and pointed toes have their place, a most definite place, and they will probably endure — certainly their end is not in sight — but that place is *not* on the basket-ball or tennis court, on the golf links, or on the baseball field, nor is it in the *workroom*. Here is a place in the fatigue-eliminating campaign where women at home can help by setting the proper example. High heels and pointed toes worn during work hours should be made the badge of ignorance or of poverty, or of both. They cause fatigue. They reduce outputs. They decrease national production when they are worn during working hours. Perhaps they also cause some physical discomfort, but apparently not enough discomfort to offset the satisfaction received from the consciousness of wearing shoes during working hours that other people wear in the evenings only. Work should be treated as the greatest of all sports, and working shoes should be selected accordingly.

Life is too short to tell this to women in a plant. It must be made unfashionable by those who set the fashions, and this is no job for production engineers! Women are not, moreover, the only ones who wear shoes unsuited to their various hours. The photographic records of soldiers' feet permanently deformed by wearing improper shoes prior to enlistment, collected by Colonel W. O. Owen and other officers of the Surgeon General's department are astounding. Mr. Elmer Jared Bliss has done more than any other civilian towards correctly fitting shoes to soldiers. It is a fact that over 80 per cent. of the soldiers in our army were misfitted before his invention and system were adopted. (See army records.) The one best way to measure and fit shoes has since been micro-motion studied and standardized.

There are some things that we can all do to help. All workers must be taught to arrange their daily work so that it will have less unnecessary fatigue. All workers should be induced to undertake fatigue study. They should be shown that fatigue study is a first step in motion study, and usually the most important factor in motion study. By studying the phenomena of fatigue, one acquires the habit of thinking in terms of the elements of motions, and as a result increases one's earning power very greatly, for the worker who can teach other workers is invariably better paid than one who cannot. Fatigue study will raise one's earning power. It will decrease one's fatigue. It will increase the length of one's productive working life. It will enable one to serve his fellow-men. And the possible savings to the nation will be the product of 35,000,000 people working 300 days each year, or 10,500,000,000 man-days, times the average amount that the extra productive time and productivity is worth per day. Set down your own valuation for possible saving per day. The sum thus arrived at is but the annual payment on unnecessary fatigue. The total sum is astounding, especially when it is realized that these great savings are possible with comparatively little effort.

Our country must have greater production in the immediate future. The employers want more profits. Labor wants higher wages. The public must have greater individual purchasing power. This combination can be helped only by eliminating waste. The elimination of unnecessary fatigue offers the greatest opportunity, and the members of this society, under the leadership of its eminent president, will respond to the needs of the people of this nation now, as they did in the world war.

TEETH AND THE WORKER *

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THE importance of good teeth cannot be overestimated. In this connection prophylaxis is vastly superior to any curative measures which may be adopted once the teeth begin to show signs of decay. Carious teeth are always a source of ill health. Such conditions as alveolar abscess, enlarged cervical glands which may eventually become tuberculous, inflammatory affections of the throat, eye troubles, pernicious anaemia, arthritic disease, and conditions due to septic absorption may all be caused by the presence of unhealthy teeth. In fact, there is no limit to the conditions which may arise to threaten the health of the individual when the teeth begin to show signs of decay. Bad teeth eventually lead to imperfect mastication and this, in turn, causes indigestion which produces malnutrition with all its attendant consequences, such as anaemia, general feebleness, lack of energy, drowsiness by day and sleeplessness at night, headaches, depression of spirits and so on. Such conditions do not make for strength on the part of the worker whose health becomes more and more impaired as a result. It is true that in certain cases the individual has a store of reserve energy on which he can fall back, but this is by no means always the case. In the average worker bad teeth mean impaired health and loss of work or diminished output. It is, therefore, of the utmost importance that in all welfare work we must not lose sight of the value of healthy teeth to the worker, whatever his or her age may be.

Let us first of all consider what are the conditions of the juvenile worker at the present time. My experience in the examination of young persons of factory age, that is, over 14 and, say, under 16, is interesting. Out of 10,000 boys and girls between the ages of 14 and 16 years, whom I examined in factories and workshops for the Home Office during the past few years, I have found a very small percentage with perfect teeth. Even where the teeth are obviously carious no attempt, in many instances, has been made to deal with them during school age. Some of those who had very good teeth admitted that they either never brushed them at all or did so at very irregular intervals. In fact, I am inclined to think that many dentifrices now sold to the public may be actually injurious to the teeth if applied too frequently. In some cases the teeth were in a very bad condition indeed, and the health of the young person was obviously impaired.

Inquiry has proved that bad teeth in young persons are due to one or another of the following causes:

1. *The Taking of Medicines in Early Childhood.*—The working classes are constantly drugging their children with such remedies as grey powder, chemical food and other mixtures containing iron, as well as patent cough mixtures, all of which tend in time to destroy the teeth. This custom is fostered by free hospital advice and medicine. Very often children attend a hospital or dispensary long after it is necessary, and continue swallowing tonic mixtures and "cough bottles" which can only do harm.

2. *The Use of Sweets and Chocolates.*—During the war it was a notorious fact that the largest consumption of confections was by the working classes. Women and children greedily ate up all they could get, irrespective of the cost. Now that the war is over the same thing goes on. The result is that the teeth become markedly affected. Sugar is good as a fat producer, but it is extremely bad for the teeth.

3. *Cigarette Smoking.*—This habit was prevalent amongst schoolchildren during the war, but it has become much more common since. It is quite common to see boys of 10 years smoking cigarettes, while in factories it is quite unusual to find a boy who does not smoke. Unfortunately, the kind of cigarettes smoked is of a very poor quality.

4. *Neglect of Cleanliness.*—The use of a tooth brush is by no means common amongst children. Even when they do brush their teeth, they are apt to do so at

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very irregular intervals. Again, many of the dentifrices in use are harmful if applied too frequently.

These, then, are some of the more important causes of bad teeth in young persons of factory age. They are all remediable, as we shall point out later on, by very simple means.

In adult workers the condition of the teeth is, so far as my experience goes, even worse than in the juveniles. In other words, the harvest of neglect in youth begins to be reaped when manhood and womanhood are attained. During the war I examined a number of women who were seeking government appointments. These women were drawn from all classes of the community. A large proportion belonged to the domestic servant group. Amongst these it was rare to meet with really good teeth. Many wore artificial sets, while a minority had had the carious teeth extracted before examination. In the majority of instances, however, the teeth were defective and some had even to be rejected on that account. It is well known that domestic servants are specially liable to suffer from indigestion and other stomach troubles. It is little wonder when we bear in mind how many of this class have defective teeth. But domestic servants are only one group of female workers. The same thing I found to be the case in factory girls, tailors' machinists, and perhaps to a less extent in typists and clerkesses. All female workers examined displayed, as a whole, a very low standard as regards the condition of the teeth.

In male workers conditions are extraordinarily bad. Out of 200 men recently examined, I did not find ten who had what one could term satisfactory teeth. Pyorrhea alveolaris was extremely common. In many cases there was recession of the gums, and tartar-covered teeth. Several workers had only a few stumps left, and these were carious. It is a remarkable fact, whether related to the condition of the teeth or not I am not prepared to say, that many of these 200 male workers had thickened arteries. Certainly the condition of the teeth is striking and instructive. It is hardly conceivable that I had discovered a special group of men. Rather, I think, we may take it that all male workers have more or less defective teeth.

If my contention that the teeth of the worker, male and female, juvenile and adult, are today in a very bad condition, then surely it is our duty to do something to rectify this state of matters in view of the facts that bad teeth have a most disastrous influence on the health of the worker and that they may even produce disease which may interfere with his work. Bad teeth may, therefore, prove to be a cause of lessened production. Accordingly both from the worker's and the employer's point of view as well as in the national interests, it is our duty to attend to the teeth of the worker.

What steps are to be taken in order to improve the condition of the teeth in the worker? At the very outset, prevention is best; prophylactic measures must be taken. In fact, much of the machinery for this exists, but it needs oiling. The school authority in every district should see to it that no boy or girl leaves school without having had the teeth attended to by a qualified dental surgeon. So far as my experience goes, parents are often to blame for not carrying out the suggestions of the school medical officer as regards their children's teeth. It is their bounden duty, however, to give every heed to this matter, and no stone should be left unturned to secure that such be the case. It is often too late when the young person enters a factory to have the teeth seen to. They may be beyond the reach of mere preventive measures then, and only extraction is possible. My contention is, therefore, that if a child has his teeth or her teeth attended to during school life there will be, in due time, a remarkable improvement in the condition of the teeth of the worker. This, therefore, is the first step in the ladder of progress towards the goal at which we aim.

When we find a boy or girl of factory age with defective teeth, what is to be done? At present all we can do is to recommend the young person to tell his parents that the teeth should receive attention. This, I fear, is a measure of practically no value whatever; even if the parents are told, they will turn a deaf ear to the advice thus proffered to them gratuitously. What I think is wanted is legislation on the subject. It should be made compulsory by law that no boy or girl who is considered by the factory surgeon to have defective teeth should be allowed to commence work until such time as a certificate has been granted by a dental surgeon that the teeth have been thoroughly treated. The impor-

tance of looking after their children's teeth would thus be impressed on parents, who would probably, from this cause alone, cease to neglect the advice of the school medical officer. In this way the law made to regulate the condition of the factory worker's teeth would very soon cease to be actually necessary, although it would still remain as a safeguard against neglect.

In some of the larger factories, especially in those which employ a welfare worker, the teeth of every young person are attended to as soon as the worker is engaged. In some cases this is done at the instigation of the factory surgeon, but in many instances the young person is taken by the welfare supervisor to a dental surgeon for his advice. In our opinion, every factory employing 1000 workers or more should have a medical man on its staff whose advice is available in case of need. Naturally the local factory surgeon, who is fully acquainted with factory conditions, is the most suitable man for such work. Such factories should also have a dental surgeon, who would co-operate with the factory surgeon, and who should be paid either a fixed annual salary or receive so much on account of each worker employed. Smaller factories might combine for this purpose, and share a medical man and dental surgeon between them.

Cigarette smoking amongst boys should be prohibited by law, and fines ought to be inflicted on boys who continue to disregard the injunction. No boy should be allowed to smoke before the age of 18. I am aware that there are certain restrictions regarding smoking amongst children of school age, but this is evidently a dead letter as I have seen boys coming out of school lighting cigarettes under the eye of a passing policeman! What we want, and must insist on having, is a law which shall be obeyed and provisions of which will be carried out by those concerned. Cigarette smoking is not only bad for the teeth, but it checks growth and retards gain in weight. I find that boys who smoke are pale, undersized, suffer from giddiness and loss of appetite, and usually have carious teeth.

So far as adults are concerned, a system of regular inspection of workers in factories is necessary. In this article I am only dealing with the teeth of the worker, but eyesight, hearing and conditions of the circulatory and respiratory systems also demand attention. I maintain that every large factory should have a system of regular medical inspection of the employees, and smaller factories could easily combine for this purpose. It must often happen that workers suffering from curable diseases go on working until it is too late, quite oblivious to the fact that they are unfit. Much might be done, therefore, by securing the services of a medical man acquainted with factory life and the conditions of factory labour. One of his first duties would be to advise the worker to attend to his teeth, if they are found to be defective. It is one thing, however, to advise; it is quite another to get the worker to carry out your advice. If, however, there existed suitable machinery at the factory for attending to the teeth, much of the difficulty would be removed. At large works, therefore, a dental surgeon should attend as often as may be necessary in order to treat the dental defects of the workers, who would so n become reconciled to the new order of things when one or two of their companions had submitted themselves to the ordeal.

Much of the money that has been and will be wasted in administering the National Health Insurance Act might be diverted to subsidizing the medical and dental supervision of factory workers. This is a preventive measure which should appeal to that newly constituted body, the Ministry of Health. We can only expect good work when we have really good workers. We can only have good workers when they are healthy and are *kept* in a healthy condition. To secure this one of the first measures, we take it, is to attend to the teeth of the worker. This is a national duty which the state, that is, the income-tax payer, should see to. By curtailing unnecessary expenses in the various departments connected with the nation's health, and by thus liberating money enough to pay for medical and dental supervision of factory workers, great benefit would result. It is sad to think that so much money has been squandered during the war, money which would have sufficed to provide the whole country for years to come with well-paid medical men and dental surgeons. As it is, we have the government contracting for a few shillings a year in return for which medical men in its service are called upon to treat the worker. Little wonder that we are a C3 nation! All this must be changed. The Ministry of Health will not bring

about such reforms as we have suggested. The employer, however, has it in his power. He is the man who finances the state, and it is to him that the state must look for its very existence. A strong representation made by employers of labour throughout the country could bring about the needed reforms in a very short time.

The health of the worker *in* the factory must be attended to. So far little has been done in this direction. The appointment of welfare supervisors is a step forward, but it stops short of what we must aim at. The workers themselves usually welcome reforms when these are found to be of practical and personal benefit. I am satisfied that it would not take long for them to discover that measures taken to improve the condition of their teeth were helpful in giving them better health. The worker today is not so shortsighted as to overlook the advantages of reforms made in his interests. Such reforms as we have suggested are badly needed at the present time, and in bringing them before the notice of employers and others interested we feel that we are opening a door which hitherto has remained closed.

THE SPIRIT OF WORK UNDER THE CRAFT GUILDS OF THE MIDDLE AGES *

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IF you look through the charters of the trade guilds of the Middle Ages, you will be struck by two interesting points. On what did they lay stress as important? First, on the duty of assistance to sick and poor members of a guild; secondly, on using only good materials, and on proper and honest workmanship. Nothing seems to have exercised the minds of the master craftsmen so much as this second obligation. The subject is referred to again and again, penalties being exacted for failure to comply with it.

The first form, apparently, which inspection took was the appointment by the guilds of so-called "searchers" in order to enforce this ordinance, and — this is important — to stamp the articles made as being of the quality and nature which they pretended to be; in other words, to give them, as is still done with silver and gold, a "hall-mark."

In 1467 an act was passed for the true making of worsteds in Norwich and Norfolk, by which the men of the craft, that is, the worsted weavers, every Whitmonday, were authorized as follows:

> "To choose a Warden of the same Craft living in the City; and the artificers of the same Craft in the county of Norfolk, the same day to choose four Wardens of the Craft in the County; all which Wardens shall come on the Monday next after Corpus Christi, and be sworn before the Mayor of the City, . . . and all the said Wardens . . . shall have full power for a year next following, to survey all the worsteds made, and make such Rules and Ordinances as they shall think meet, for the good of the Craft. The Wardens have full power to search all Worsteds in Norwich, Norfolk, Suffolk and Cambridge, as well in the looms as out, and to convene any persons that are faulty or disobedient to the Ordinances, before the Mayor . . . who shall punish them at their discretions, and every man shall put his proper mark on every piece on pain of forfeiture. The Wardens shall assign a certain place or two in the City, and others in the Country, and certain days every week, when every piece shall be brought and searched by them, and if approved, they shall put their Token or Seal thereto, without fee or reward; and all Mayors, Sheriffs and Bailiffs, when the Wardens require them, shall be attending, aiding and supporting them in their search."

Think of it — every piece of cloth inspected and stamped by the "aulnagers," as they were called, of the guild! And I have seen the rooms in the Guild Halls of Norwich and Witney, in which this was done.

Equally emphatic and more graphic are the Ordinances of the Spurriers' Company of London, enacted in 1345, for prohibiting night work because it militated against honest work.

> "No one of the trade of Spurriers shall work longer than from the beginning of the day until curfew rung out at the Church of St. Sepulchre, without Newgate; by reason that no man can work so neatly by night as by day. And many persons of the said trade, who compass how to practise deception in their work, desire to work by night rather than by day; and then they introduce false iron, and iron that has been cracked, for tin, and also they put gilt on false copper, and cracked. And further, many of the said trade are wandering about all day, without working at all at their trade; and then, when they have become drunk and frantic, they take to their work, to the annoyance of the sick, and all their neighbourhood, as well by reason of the broils that arise between them and the strange folks that are dwelling among them. And then they blow up their fires so vigorously, that their forges begin all at once to blaze; to the great peril of themselves and of all the neighbourhood around. And then, too, all the neighbours are much in dread of the sparks, which so vigorously issue forth in all directions from the mouths of the chimneys in their forges. By reason thereof it seems unto them that working by night should be put an end to, in order such false work and such perils to avoid; and therefore the mayor and the aldermen do will, by the assent of the good folks of the same trade, and for the common profit, that from henceforth such time for working, and such false work made in the trade, shall be forbidden."

Each guild had its own seal which was attached to the article made, to assure the buyer of the soundness of his purchase. Great pride was taken in the smallest detail, even pathetic interest, in some cases. Nowhere were the arms of the guilds represented more exquisitely or with such imagination as in Florence, where the greatest artists, such as Luca della Robbia, were commissioned to execute them. What could be finer, or more stimulating to the imagination than the coat of arms, carved

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in stone, of the Guild of the Cloth Workers (Fig. 1) — an eagle flying, holding two bales of cloth — indicating that the cloth which they manipulated was brought from far distant countries, and that the only bird worthy of carrying it for the transformation they alone could effect was the king of birds, the eagle. For you must know that for centuries Florence was preeminent in the dressing of cloth.

In the Middle Ages a man or an apprentice who aspired to become a master-craftsman and to carry on trade was obliged to make an essay-piece, which was examined by three judges. I give some examples of the essay-pieces required:

> Of a blacksmith in Aberdeen — "ane big lock with pipe and six cross marks;"
>
> Of a coppersmith — "ane brass tea kettle and broath pott tinned;"
>
> Of a watchmaker — "ane eight day clock to be made and perfected by himself and wrocht with his own hand;"
>
> Of a goldsmith — "a silver sword hilt, a small brandy dish, and a gold ring."

About 1750, the essay-piece required of the wrights, or cabinet makers, was pretty stiff:

> "A spring table, consisting of three folding leaves, every leaf folding above another: the first leaf when folded over is to answer a dining-table; the second leaf to answer a quadrile or whist table; the third leaf to answer a backgammon table; the said three tops are to be hung on one pair of hinges; out of the said table is to arise a writing-desk with nine drawers, and a book frame on springs, the said frame to have eagle claw feet with a shell or flower on the knees of every foot; the said table is to have close banded and chequer feather bands."

Insufficient work, work not up to the standard, was seized and forfeited. Witness a statute of 1694:

> "Lykwayes condiscends yt ane timber chest be made for holding and keeping of the insufficient work yt shall be found amongst hamermene in toune or in the mercat, and ordains the sey masters to search and sey the mercat ilk mercat day at ten hours in the fornoone." (*History of the Hammermen of Glasgow.*)

Now, what does this care for honest work mean? It means that in the Middle Ages they knew the quality of the material in which they worked, and they were determined not to degrade it. By quality is here meant the fitness of the material for the use to which it is put, or to the object made of it. This appreciation of the quality, appropriateness, capacity, and limitations of a material is at the root of all the beauty of workmanship executed by the craft guilds, just as the absence or neglect of it is at the bottom of the ugliness of much modern art. Because of its observance in regard to pottery, your great painter, Whistler, has said:

> "Art, the cruel jade cares not, and hardens her heart, and hies off to the East, to find among the opium eaters of Nankin a favourite with whom she lingers fondly — caressing his blue porcelain, and painting his coy maidens, and marking his plates with her six marks of choice — indifferent to her companionship with him, to all save the virtue of his refinement. He it is who calls her — he who holds her."

It is not machinery which is at fault; machinery is but a servant; machinery, so to speak, adds so many more hands for you to work with and, if those hands are only properly used, they will do away with an infinite amount of drudgery, of work which no man ought to be asked to do (such, for instance, as boot making or glass bottle making), will enable you to get through your work more expeditiously, and so give you more leisure. Have you ever thought of the fact that there is not a single operation through which any article in the course of its manufacture passes which is slipshod and shoddy? Operation, I say. The machine works almost perfectly within its limitations. There are, it is true, plenty of shoddy articles to be bought, which fact we must attribute, not to machinery but to our loss of good taste and to our desire for cheapness. Welcome, therefore, to that marvellous machine, the product of American invention, which automatically sucks up the "metal" (for so molten glass is called), pours it into the mould, blows it, and, controlled by two men only as compared with the forty required hitherto, delivers bottles at the rate of fifty a minute, thus saving human labor, obviating glass workers' cataract and increasing output.

What you must not ask of machinery is to add ornament, or a flourish. That can only be done by the thinking hand. Make picture frames, if you like, by machinery, but let them be straight and plain. Gates or palings made of cast iron must have simple straight lines, if the material is to be rightly used: any attempt to imitate in cast iron what can be effected only in

wrought iron, is to use it wrongly. And so it is with ferro-concrete. At present it is being rightly used in straight lines. Do not attempt to mould it into statuary. And do you think that in the Middle Ages they would ever have supposed paper to have the quality of wood? They appreciated linen fold ornament on wood panelling, but would they have tolerated, think you, lincrusta paper squashed to look like linen fold ornament?

I must emphasize this point — the appreciation of quality of fitness of material

FIG. 1. — Arms of the Guild of Cloth Workers — eagle carrying two bales of cloth.

— so that you can have no mistake as to its meaning. We sometimes speak of stained glass as a lost art. Why? It is only a lost art in so far as the quality has been lost which glass and lead should exhibit in the construction of stained-glass windows. Take the quality of colour. As beautiful glass as ever was produced in the Middle Ages is being made today by artists who make it in the same way — with uneven surface, uneven thickness and, above all, with bubbles of air caught and retained within the glass. These give the glass a veritable magic power of breaking up and scattering the light; the result is a translucent glow of colour, its richness varied because the glass, being of uneven thickness, at no two points will allow colour of quite the same wave-length to pass through. You can never have beautiful stained-glass windows if you want to look through the glass. Nor can you have beautiful glass unless the lead is used to form the structure and hold together as a mosaic the little pieces of coloured glass.

Take another quality — the quality of glass to transmit light. To use squares of white glass and paint them so as to have pictures on glass cannot be done without dulling its surface and interfering with its quality of transmitting light. Thus, to fail to recognize the quality of the material you are dealing with is to court artistic death.

Nowadays, the reason why we admire straight lines in iron and steel construction and in ferro-concrete building is intrinsically because the quality of the material is respected and treated as it should be. We dislike, or should dislike, imitation Gothic architecture by means of iron and steel pillars and arches in churches and railway stations, because these are cases of putting the material to uses for which it is not qualified. But when you treat a material with the respect due to its quality probably the greatest good which you yourself will receive will be interest in your work. To my mind, this explains more than anything else the beauty of the work carried out by the mediaeval craftsman. He forgot the long hours, giving himself entirely or throwing himself into the thing he was doing. He must have handled his tools lovingly as the instruments which, under the guidance of his brain, wrought slowly and surely the task he had set before him, quite confident in his own ability, and no wonder. Had he not behind him a long apprenticeship? Had he not already proved himself by his essay-piece a skilful workman, worthy to be enrolled as a member of the craft? Was there ever a more beautiful expression of the joy in work than that given in the Bell-Founders' Window in the nave of York Minster dating from the fourteenth century, one of the three lower panels of which is reproduced? In the centre panel the donor, Richard Tunnoc, is kneeling presenting the window to the Archbishop. In the right the core of the mould is being shaped. One figure is turning it with a handle like a grindstone, and another with a long crooked tool (which he holds firmly with both hands, one end being placed under his right armpit) is moulding the clay to the proper form, giving his whole mind to the task. In the left panel the metal is being poured, with the furnace, bellows and apprentices all brought into the picture. The background

is blue glass, richly diapered, and above at the sides and below are bells, bells, bells.

Not until the workmen of today, in factory and workshop, can recapture this interest in their work can we expect the same fine results from them. The greatest boon which I look forward to from the shortening of the working day is the fact that people will have leisure to learn again to make things they will take pleasure in. They will have two hours at least which they can call their own and will not be too tired to use. At present, in towns, workmen's houses are not built so as to allow of a workshop in them. But one great means to bring this about is to teach children in school the use of their hands. Then later, with communal workshops instead of or, I might say, as well as billiard halls, craftsmanship will have a chance to come into its own again.

We must remember this, that under the craft guilds there was nothing resembling the present system of competition. Their object was to limit competition, and this they did by not allowing any master to have more than one apprentice in order that work should be equally distributed. So far as the supply of commodities to the public was concerned, the position must have been not unlike that which we have recently gone through in the rationing of certain foods. The craftsman asked a good price for honest work made of sound material, which would consequently last a long time. He did not try to dodge his neighbour and undersell him. The question of cheapness did not come in. Only occasionally do we read that the municipality had to interfere, to regulate the price of goods because of extortion. A regular scale of charges was recognized, and the skill of the craftsman counted for what it was worth.

So far as the craftsman's social life was concerned, his interests centred most in his guild hall, in the ceremonies there conducted of initiation, election as a master craftsman, election of the warden, the banquets, the processions on holy days, and, on the death of a member of the craft guild, the rites performed in the guild chapel or chantry. Lastly, those quaint and solemn mystery plays must have stirred his soul and enlarged his imagination.

Certainly our forefathers did try to make the world of trade a world of excellent workmanship. The regulation that "a master craftsman should work at his own hand for two years after his admission before taking an apprentice . . . ensured that all masters should be expert workmen themselves . . . also that an apprentice would have an expert master to teach him." And the reason of the rule that a master should only have one apprentice at

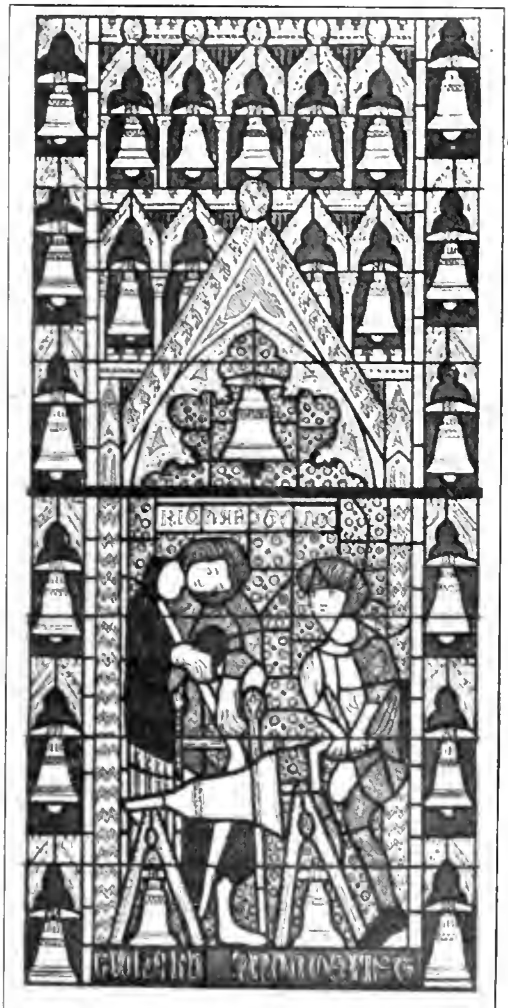

FIG. 2.—Bell-Founders' Window, York Minster, showing polishing of the core for the mould. (*Fourteenth Century.*)

a time was "to keep the freemen of the trade on an equality. Where the number of apprentices was limited, there could be no amassing of riches at the expense of the poorer craftsmen, for there could be no fierce competition. Indeed, competition could only be indulged in under the form of a rivalry in turning out better work, and not in turning out cheaper work than another. This kind of competition tended to bring out a quality of workmanship that would command the market. Bad work could never reach the market unless it

escaped the scrutiny of the searchers. Cheap work was unknown, for prices were regulated. Quality was thus the only means of competition, and this forced the master to select a clever apprentice or servant, and to train him to the best of his power." (*History of the Hammermen of Glasgow*. Lumsden and Aitken.)

On the guild hall was expended all the talent of all the crafts combined, as we can see in those which still stand; not only in the beauty of the buildings, as in the guild halls of London, York, Coventry, Lavenham and Exeter but also in the details of internal decoration, and in the furniture and fittings. Alas! That the Cloth Hall of Ypres, the pride of centuries of craftsmen, peerless in beauty, should now be nothing but a heap of ruins. Pride in the workman's tools and in the merchant's mark is expressed and emphasized, for they are emblazoned on shields, carved in stone or wood, or set in stained glass. The merchant and craftsman were out to have things beautiful and to have them of the best.

The ceremony of initiation into apprenticeship was intended to be invested with dignity and solemnity, as witness the following oath administered by the Mercer's Company:

> "Ye shall swear that ye shall be true unto our liege Lord, the King, and to his heirs, Kings. Also ye shall swear that well and truly to your power ye shall serve your Master during the term of your apprenticeship. And ye shall hold and perform the covenants in your indenture of apprenticehood contained. Also ye shall hold steadfastly, secretly and for counsel all and every the lawful ordinances, whatsoever they be, to the Craft or occupation of the Mercery belonging, and, as much as in you is, every one of them, ye shall observe, hold and keep, and not to break, discover, open or shew any of them to any person, but unto such as unto the fellowship of the Mercery is here according to this oath sworn. And that ye shall not depart out and from the said fellowship for to serve, not to be accompanied with any manner of person of any other company, fellowship, occupation or craft, whereby any prejudice, hurt, or harm may grow or be unto the fellowship of the Mercery, or any of the secrets thereof thereby to be discovered or known. So help you God, and all Saints, and by this Book."

The day of days to the members of a guild was the festival of their patron saint when the warden of the year was elected. Then all the members, attired in their livery suits, would assemble at the guild hall and go in procession to attend mass, celebrated by their chaplain at the guild chapel in the parish church. After attending mass, the members of the guild would return with their wives and families to take part in the banquet prepared on ceremonious occasions and, finally, as epilogue to the banquet and business, the day would end either with a Miracle Play or with Morris dancing. In the acting of the Miracle Plays, members of the guilds took the most prominent part, and to one and another guild were assigned the particular properties and parts it would have to be responsible for. Thus the shipwrights, fishermen and fishmongers would enact the story of God foretelling Noah to make an ark of light wood, and Noah in the ark with his wife and diverse animals; the goldsmiths and moneymakers, the three kings from the East offering gifts; the vintners, the feast at Cana; and the bakers, the supper of the Lord and the paschal lamb.

I would pause here and ask you: What is there comparable to the guild hall in the life of the trade-unions today? Hardly a union in Great Britain is housed as it should be in a building worthy the great objects and aims it stands for. Trade-unions are the inheritors of the traditions of the trade guilds. Let them carry on the tradition of what was best in their great predecessor. A great future lies before them. Let them, then, feel their responsibility. Wages and creature comforts of their members — these, I grant you, must come first but these happily are now in sight of attainment. Let them look into vistas beyond. And at least let them try to house their unions in worthy buildings, everything in simple taste, showing that they are mindful of their high calling.

Perhaps the best attempt which has been made in London in modern times to raise such a building is Unity House, the home of the Amalgamated Society of Railwaymen. The façade of white brick is in good proportion. The council chamber on the top floor is a beautiful room, well lighted by leaded lights containing slab glass, let into which are, in coloured glass, the arms of the Society and the tools of the workmen, arranged in a pattern. On the large oriel window on the staircase are panels of glass representing plate layers at work, engine drivers on the footplate, the mysterious approach to a tunnel, and other representations, all good in intention but, alas, so inferior in material and execution.

Lastly, I may just mention that the connection between the guild and the church was very close, being the closer the earlier the date. In addition to the patron Saint, in most of the larger guilds, there was a regularly appointed chaplain to conduct services at the stated meetings, and to look after the spiritual interests of the members. I have said that each guild had its patron saint. Let us try to picture the altar of one of these saints in the old Cathedral of Glasgow somewhere about the year 1530, the spacious interior empty of pews and with side chapels ranged along the walls, each with its altar decked and draped and garnished with lights and flowers.

We are looking for the altar of St. Eligius the patron saint of goldsmiths and of the hammermen of Glasgow. St. Eligius, you must know, was born near Limoges in France in 588 A.D. He worked under a goldsmith and became so skilful in the craft that, on going to Paris, the king entrusted him with the duty of making a throne. Eligius found that the metal given him was sufficient to make two thrones. This brought him great honour, and he was made Master of the Mint, and struck coins. In 640 A.D., he was made Bishop of Noyon, and died in 659. Therefore, he became the patron saint of workers in metal. A little statue of him, hammer in hand, finds an honoured place in the restoration of a mediaeval smithy in the armour room of the Metropolitan Museum of New York.

"Let us pause in imagination before his altar, draped in fair white linen and gay with its green or red frontal . . . a richly bound missal occupies one corner and a chalice the other. In the centre of the little super-table stands the tabernacle, of Flemish carved work. . . . In front of the altar stands the priest's reading-desk, and flanking it are two torches

FIG. 3 Room in the Guild Hall of York. (*Fifteenth Century. Photograph by B. T. Batsford & Sons.*)

that are only lit on high solemnities. . . . Fresh flowers adorn the altar, and . . . if we look beneath it we may see the handles of the 'hers', a frame of wood something like an ambulance litter, on which the coffin of a deceased hammerman was laid in front of the altar and covered with the rich pall of violet. . . . Hanging above, the undying lamp adds its small gleam to the other altar lights and shows up the gilded crown and hammer that dangle from a pillar bracket, like a shop sign, and indeed for the same purpose — to symbolize the spot and mark it out as the hammermen's altar. . . . Such, we may imagine with great verisimilitude, was the ancient altar of the hammermen of Glasgow in the days before the Reformation." (*History of the Hammermen of Glasgow.*)

PHYSICAL EXAMINATIONS *

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COUNTLESS physical examinations are given all over the country by many different kinds of organizations — insurance companies, factories, stores, institutions, clubs, benefit societies, colleges, schools, gymnasiums, orders, etc. A tremendous amount of time and effort is put into these examinations by many doctors. It would seem wise to look over the results of so much work and see whether they are, on the whole, adequate or whether, as I believe to be the case, the results could not be many times multiplied if the examinations were done from a somewhat different point of view, with somewhat different emphasis, and somewhat more completely.

The point of view from which a large proportion of the examinations are done now is that of obtaining *certain data* for the organization requiring the examination. Such organizations must be given first the facts they need in regard to the examinee, whether he is a good life-insurance risk, a safe man to employ, a valuable member of an order, a suitable candidate for admission to a college or a ball team — in other words, whether he will be an asset or a liability. So general has been this impression of the physical examination, that for a long time organized labor opposed the compulsory examinations connected with employment departments of factories. It was thought that the most desirable factories to work in, which would be the first ones to go in for these examinations on account of their superior facilities, would utilize the examination to pick out only the stronger applicants, and would turn down the weaker ones — men who need to work as much as the strong. This would have indeed been unfortunate, for the weakling might then have been prevented from getting work altogether, or would have had to work in the less desirable places. It was later seen — and we helped to demonstrate it in the factory where I had charge of all the examinations of the 3000 women employees — that such examinations were not for the purpose of turning down anyone who was fit to work anywhere, but were for the purpose of fitting any applicants, even the physically handicapped, into the work for which they were best adapted physically, where they would injure themselves least, possibly benefit themselves, and continue to work longest. We did not turn down anyone fit to work at all; we had as large a variety of work to offer as was to be found anywhere, and could thus adapt the person to the work and *vice versa*. Only applicants who would have been a danger to the persons working with them on account of serious infectious conditions, and applicants who ought not to have been at work at all were definitely turned down, and we tried to see that these were looked after as their condition required. Organized labor now realizes, I believe, that there is at least this advantage from the physical examination as it is usually done at the present time.

Aside from data obtained by the organization authorizing examinations and the benefit of selected placement to the employee, very little benefit has accrued to anyone else. The organization, of whatever kind, thinks it has got all it needs, all it has asked and paid for, and is satisfied. The examinee either takes it quite indifferently as something which he has to go through whether or no, or else he feels vaguely disappointed that in an examination of himself he himself should be of so slight importance. His mitral first sound and his aortic second, his external ring, yes! But he, himself, no! From so many physical examinations there should be three other beneficiaries besides the organizations, and even the organizations themselves are not benefiting from examinations as they should.

The other advantages which should be forthcoming are, first, the *advantage to the doctor himself* of so much experience in examining all sorts of human bodies. That this advantage does not often result is due to the fact that the doctor is usually unselfishly thinking first of his duty to the organization employing him, and, of course, his duty to them is done when

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he has made as brief an examination as will suffice to supply them with the data they want — when he has catalogued his findings and pigeon-holed his patient. All the interesting glimpses he gets of conditions he would like to investigate more thoroughly must be passed over unless they have some bearing on the question in hand, if he is to do his full quota a day. "Piece work" is about what many factories expect of the doctors they employ. There is seldom time enough permitted to make such an examination of each patient as would result in the real gain of valuable experience for the doctor. From the point of view of the organization, medical work good enough for its purposes may perhaps be done in a hurry, but from the point of view of the doctor himself, if he is to continue educating himself day by day, he must have time to do it in. By this I do not mean dawdling over an examination. Many tests we take minutes over can be done in seconds by developing one's technique. But to continue persistently working against time means to throw persistently away opportunities for knowledge not to be gained except through painstaking work. It has a disastrous effect on the medical conscience as well, even though we learn to make snap judgments — often right too — about a patient.

The gain from so much work put into physical examinations, however, should not all be reaped either by the organization or by the doctor himself. All medical work that is worth doing should *contribute to the sum total of scientific knowledge*. Data should be available as a result of these hundreds of thousands of examinations — data which would throw some light on physical conditions everywhere. Doctors are as a rule particularly averse to keeping records, and, for the purpose for which the examinations are made, very few records are demanded. How many records of physical examinations are a series of dashes and check marks, indicating either that the organ referred to is all right or is not all right! This may be all that the employer demands, and it may not indicate that the physician himself while getting the data did not receive valuable information to aid him in his future work, but it does not add very greatly to medical knowledge as a whole to know that out of 1000 mouths examined the teeth "got by" in 768, or that of 1000 chests examined the heart was adjudged safe in 853 cases. We would like to know, and it seems to me we have a right to know, in more detail what was found. Work done on such a large scale as physical examinations are done in this country should be made to show results to all those interested in the work, and it seems to me that medical science should be considered one of those chiefly interested.

By the use of a system of colored clips of sixteen different colors, which in addition have different numbers, and by placing them in varying positions on the top of the card, a doctor can indicate his findings so that a clerical person can tabulate them with very little additional work. The placing of the clips is the matter of only an additional moment. Then the dashes can be used to indicate a negative condition and all abnormalities described in writing without adding greatly to the length of the examination, if the blank is arranged with that end in view. I have used the various colors to indicate the various parts of the body; the numbers to indicate "permitted to do any work," "permitted to do work to which assigned now," "not to be given any work without consultation with doctor," "given hygiene advice," "given medical advice," "receiving care outside," "referred outside," etc. The clips are placed on the card in such a way as to indicate severity of the condition, mild being placed at the left and most serious at the right. A plain metal clip is placed on the card in such a way as to indicate when the patient is to report for re-examination. For example, a black clip with the number "5" on it, placed in the middle of the card, accompanied by a metal clip at the extreme left, would indicate a moderate degree of organic heart trouble, compensated, receiving adequate care from his physician, to report to medical department after work with us two months. The system is capable of elaboration according to the needs of the particular clinic, the numbers, colors and placing indicating a different set of things. It no doubt seems rather complicated but familiarity with it comes rapidly, especially if assistance is given by a competent clerk. In order to make the record still more complete, the data can be grouped at the end of every day or week, so that it will be possible to tell at a glance, provided the clerk is as competent as she should be, how many of those examined had, for example, defect-

ive eyesight, with or without symptoms, how many were wearing glasses, whether they were referred for examination of the eyes, and on what day they will be found waiting in the office for a second consultation.

Finally, supposing the doctor, the organization and medical science have received their share of gain from the examinations, what of the result to the *patient himself*, or herself? Many a girl whom I have examined for employment has never in her life had the hands of a doctor upon her. She comes to the experience in fear and trembling, but still hoping that it will bring her something to make the experience worth her while. It is not only the job she is interested in. This is evidenced by the fact that many a girl will tell about conditions and symptoms that might not be discovered and that she has every right to expect will exclude her from the work she needs to get. But she tells about them because she has for the first time come in contact with a physician and, with the faith of a large portion of the laity in physicians, she lays bare her very soul, in the confidence that the doctor will do not only his duty to those employing him, or his duty to himself, or his duty to medical science, but will do also the square thing by her, and will give her something of value in the guarding of that most precious thing to the working girl — her health. Although she has never sought out such an opportunity before, and perhaps never would have, when brought face to face with it she knows that it ought to be of value to her. Her eagerness often seems to be the reaction to years of repression, forced upon her or not, of an interest in her health. The doctor who permits lack of time or any other consideration to interfere with this duty to the patient must indeed be lacking in human feeling, if not also in an understanding of the ethics of his profession.

But even if the patient takes the examination quite indifferently, the duty is still there, perhaps even more emphatically there, for there is nothing that needs more the vigorous attention of doctors than the *laissez faire* attitude toward health on the part of a large portion of the public. If a consideration of his bodily condition seems a mere incident to a man, with no possibilities beyond that of getting the position he wants, or the life insurance policy, or the admission into college, then he is indeed in need of waking up to a realization of the vital importance from every point of view of the question of health. So, whether the patient wishes it or not, it seems to me that we owe it to him to give him as the result of the examination something which will enable him to become a better man.

The best way in which the opportunity afforded by physical examinations can be used to the general advantage of everybody concerned, is to make each examination as complete as possible, and to make each examination an *educational* one. We can look upon an examination as an opportunity to detect beginning defects and see that they are followed up. Or we can look upon it as an opportunity to institute medical or surgical treatment for those who need it, simply passing by those who seem well. Or we can look upon it as an opportunity to educate toward health each and every one with whom we deal. The great value of curative treatment and of early prevention is not to be minimized, but the time has come when we must begin still farther back, giving those who are still well the knowledge of how to keep so. These are the people who do not ordinarily come in touch with doctors in any other way than during routine examinations, because, following the usual custom, they avoid doctors until, in illness, they are forced to call upon them. And yet these are the very ones who, by the way they are conducting their lives now, are preparing the way for the need of much medical attention later on. If they could be taught not only how to avoid disease, occupational hazards, infections and so on, but how to *keep health* by their habits of living, there would be as great an increase in the welfare of the whole race as there has been in baby welfare since the lives of babies have been so generally put upon a health basis. There is no real living for a tremendous number of the working people of the country, not because of definite illnesses but because of the absence of the full vitality which might often be obtained without changing an entire manner of life but by changing a few habits which hamper full living.

I do not mean to underestimate the necessity of doing more than educating the individual or the importance of all public and social health endeavors. I simply wish to stress particularly, as the duty of each individual physician in each examination, the importance of the personal aspects of health. Whatever the conditions of living

may be, there is an individual maximum of health which may be reached under those circumstances and which seldom is reached. There are many reasons why it is not reached, one of which — perhaps not the most important — is ignorance. And this ignorance must be laid partly at the door of the doctors. We must devise many ways of overcoming this ignorance but in the physical examination we have one already devised, an opportunity which cannot be improved upon for giving education in the most effective way — the contact being between the doctor and one individual, at a time when the thoughts of that individual are already directed toward the subject of health, often when something is depending on what his health is found to be, and when everything that is said to him after an examination will be understood to be applicable to him as an individual. If at such a time we endeavor to give him an idea of where he stands, which way he is tending, and what will enable him to go up hill instead of down, not only when it is a matter of medical or surgical treatment but when it is merely a change in habits, an improvement in the way he lives, what he eats and drinks and wears, and how he spends his time and energy, he is practically certain to be interested in the matter and to do something toward carrying out the advice.

Of course, in order to have the advice worth anything, it must be based on a somewhat more complete knowledge of the patient's condition than is usually obtained in routine examinations. In fact, it should be based on as complete data as can possibly be obtained if it is to be of the greatest value. The blank given below seems to me to include about the minimum of information desirable as a basis for health education. In addition to this, familiarity with the conditions under which the examinee lives is an essential to an adequate consideration of his condition. Different schedules would have to be made out for each class of examination to cover these facts. Also a schedule would have to be used giving similar data in regard to working conditions. If it is fitness for any kind of work or activity which is being discussed, the physician should know what the nature of the work is to be and what the patient has done before in this or other lines of activity. A factory physician should, of course, be perfectly familiar with the kinds of work done in the factory for which he is examining — college and gymnasium examiners, etc., too — with the various kinds of strain and the opportunities for development or injury involved. At least one physical examiner has actually done the various kinds of work for which he was "passing" applicants, in order better to determine what their results were likely to be, what were the particular qualifications required, and how they could best be used as a means toward health.

When all this data is in and any special diagnoses made, we then have an adequate foundation on which to construct for the patient's benefit a régime of healthful living. In any series there will, of course, be many who do not need so much examining and who do not need any advice from the examiner in regard to their condition. Chief among these are the ones who, we find, are already properly looked out for by another physician, and the ones whom we find it necessary to refer to others for care beyond that of health education. It is our responsibility, however, even in these cases, to make it sufficiently clear that there is something for somebody to do; and, furthermore, to help the patient into getting the right point of view toward health, to appreciate its desirability as a source of joy and success, and his own ability to gain at least his own maximum of health.

It will probably be thought that the extra amount of time required to give as thorough an examination as this, in every case where examination is given at all, would prohibit its general use. But the advantage to the public is ample reward for the additional time consumed; and there would not be so many people about in the world with no faith in doctors if each doctor really interested himself primarily in every possible way in the health of his patient, not only as he finds it but as he sees the patient is daily making it or marring it. Furthermore, if doctors would insist upon having opportunity for complete and educational examinations, organizations would soon see the inestimable advantage to themselves of having not only a cursory knowledge of each man examined, but of having a part in making each examinee a still greater asset to himself. The inevitably closer relation which would exist after a complete, educational physicial examination between the doctor, who represents the whole organization to employees, and the patient would result in a morale which

HEALTH EXAMINATION

Date Examiner..........................

Name Age....M....S....Ch. l ...d....ms....sb.............

Address Business address

Birthplace	of father	of mother
Occupation	"	"
Health	"	"

Family History

Cancer	Epilepsy	Kidney	Arthritis	Blood vessels
Mental	Nervous	Heart	T.B.	Diabetes

Patient's History

Measles	Tonsillitis	Chorea	Skin
Whooping cough	Bronchitis	Ac. rheum	Otitis media
Scarlet	Influenza	Typhoid	Operations
Diphtheria	Pneumonia	Adenitis	

Remarks:

Habits

Sleep: duration continuous refreshed windows open dream

Bathing: warm	tub	shower	sponge	night	morning	per week
cold	"	"	"	"	"	"
ocean				swimming pool		

Teeth: tooth brush used per day powder paste floss

Clothing: corset type shoes underwear

Diet: appetite	tea	meat
regular	coffee	sweets
hastily	alcohol	vegetables
between meals	milk	fruit
what ?	water	

Elimination: Urine, d...n..., polyuria dysuria

Bowels: reg. without laxative interval constipation diarrhea

Menses: regular	interval	duration
flow moderate	excessive	scanty
pain, abd.	back	reflex
time lost	bed	leucorrhea

Headache	Palpitation	Frequent colds	Pain
Indigestion	Dizziness	"Catarrh"	Swelling
Change of weight	Dyspnea	Cough	"Nervous"
Undue fatigue	Syncope	Perspiration	Convulsions

Medicine and drugs: Alcohol Tobacco

Exercise:

Recreation:

Examination

General appearance M.M. Tonsils

Nutrition Nose Lymph glands

Skin Tongue Thyroid

Cleanliness Throat Deformities:

Eyes: vision pupils disease glasses

Ears: hearing disease

Teeth: 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 cared for Gums, inflammation
8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 need dentist pyorrhea

Heart: Inspection: pulsation

Palpation: apex diffuse thrill

Percussion: rt. border left

Auscultation: quality of sounds P. 2
murmurs: area time after exertion

Pulse: rate rhythm after exertion: rate rhythm

Diagnosis:

Lungs: Inspection: diminished expansion depressions
Palpation: tactile fremitus
Percussion: dull flat hyper

Auscultation: B, b. B.v.b. cogwheel
voc. frem. friction râles

Diagnosis:

Blood pressure: systolic diastolic pulse pressure

Temperature: Hemoglobin

Abdomen: muscles fat ptosis bowels
scars tenderness hernia tumor

Extremities: varicose veins joints
edema inco-ordination fingers, tremor
clubbed

Reflexes: patellar plantar abd. skin

Spine:

Posture:

Feet:

Remarks:

GRADE

any organization would be glad to cultivate if it knew it could be cultivated thus.

This more complete type of examination is the natural sequence of the work doctors are now doing. First their work was to restore health; now it is to prevent illness. Most organizations are now handling both of these aspects of the care of their members or employees. The next step is to maintain the health of employees while it is still present — the highest aim from the human, scientific and economic point of view. By a change in the point of view in giving examinations from that of acquiring knowledge for our own or our employer's use to that of giving knowledge to the patient, many thousand people would acquire health education in the natural course of events; disease prevention by organized groups and boards of health would be made less necessary; and at the same time those having the examinations done, the doctors making them, and science itself would benefit.

The only conditions under which the so-called routine examination as now given — of which from a dozen to forty can be done in a morning — is to be tolerated is when it is thoroughly understood by patient, doctor, and employing concern that the examination is incomplete, has value only for a specific purpose, and is to be discounted as soon as an opportunity offers itself for completing the work. It is as if the patient were considered satisfactorily examined at the admitting desk of a hospital, in the brief examination necessary for admission. Such examination has its place, for example, in showing that a patient has a possible acute appendicitis and must be admitted for further examination and treatment. So also, if in a factory examination an applicant is found to have frequent headaches or bad habits of eating, it is justifiable to let it go at that and admit him, but it is culpable neglect on the physician's part not to see that he gets further advice or treatment somewhere by someone at the earliest possible moment. Little wonder that no physician with much feeling for science or humanity can be interested in examinations where speed and half-complete data are the first requirements. We should one and all refuse to be a party to them, for they necessitate slipshod medical work and the avoiding of medical responsibility. The surgeon who neglects after-treatment is no more genuinely culpable than the physical examiner who fails to bring profit to the patient as a result of his examination.

Positive harm sometimes results to the patient from examinations such as are sometimes given. The patient may be alarmed at the silence prevailing during the examination, or at the words he catches if the doctor dictates, or he may get a false sense of security in the face of definitely bad tendencies. I have seen an old man with nephritis passed for work during the war, on the supposition that he would last until the young men got back and with the feeling that, since he must work somewhere, he might as well work where he was. But the old fellow, since he was passed, thought his condition was good and did not heed the casually given advice to see his own doctor. The latter advice was well meant, but it did not "get over." The doctor probably did not say more in the mistaken notion that by so sharply limiting himself he was observing medical ethics. So an examination may not only fail to be educational and a benefit to the patient, but may actually be misleading.

This extension of factory and routine examinations so as to include an educational element will not by any means interfere with the work of general practitioners in the community. On the contrary, they will see more patients than ever before — those who would naturally visit them and those who are sent them by physicians who have made examinations which call for further attention. The examiner who talks to the patient — not an "Mm . . . m" doctor — frequently arouses an interest in health or possibly in the lack of it to such an extent that the patient is anxious for the first time in his life to get the former and to get rid of the latter, and hence goes to the much dreaded hospital or doctor. Having come in contact with a not very formidable member of the race of doctors, he takes new courage in regard to the species and in regard to his own health.

There are certain aspects of physical examinations which appeal to both doctors and laity alike, chief of which is that of detecting beginning defects before they have even been suspected by those who consider themselves well. As it should be, this is often mentioned as one of the foremost advantages of routine examinations, and is much emphasized by some medico-commercial firms dealing in health. It

often takes some time to show visitors to the Health Center that there is anything more important than this in our work. Of course the discovery of beginning defects is of much value, as is also the opposite circumstance — an aspect seldom mentioned but the source of much satisfaction to those doing examinations complete enough to bring out such findings — that is, relieving a patient's mind by telling him that he is not suffering from some disease which he feared. Many girls are haunted by the fear that they have inherited diseases from their parents — conditions which we can often show them are not hereditary or at least have not been inherited. Often girls interpret minor signs of ill health as symptoms of serious disease — heart, lungs and kidney being the most common organs suspected. The symptoms are frequently found to be due to faulty digestion, mild anemia, poor muscle development including heart muscle, slight cystitis from concentrated urine, or lumbar pain from poor posture — all eradicable by changing certain habits of life. Nothing but a complete examination and positive assurance based on it would shake the patient's belief in these bogies. Fearing to hear the worst, these people often postpone having examinations on their own account and accept them almost reluctantly when offered as part of a routine. When reassured and told that in correcting these few habits they can be well, the whole psychological point of view is changed; they do as advised and become well. But if the examination is hurried and incomplete, and the information obtained kept entirely in the doctor's own possession, a splendid chance for health education and health achievement is lost.

There are many beneficial results of examinations as given now, and for that reason they are becoming deservedly popular with the public. In fact, out of many thousand applicants I have had but two or three who withdrew their applications when they found that they would have to be examined. The change we can make in the examinations to give them greater value still is to do whatever is done so thoroughly that, first, it will count for something in the way of experience for the doctor; second, that it will be a contribution to medical knowledge; finally, that it will be of educational value to the patient so that he will leave knowing not only that he has or has not certain conditions in his body, but knowing also that he is or is not doing the right thing to keep his health. A physician's duty to everybody concerned, including himself and science, may be admirably done, but his duty to his patient is not done if after the examination he fails to do everything in his power to add to the length, breadth and depth of the patient's life, even though it may variously consist of anything from merely handing the patient over to the right man to spending an hour in talking to him. Nor is the physician's duty to society done if he fails to build into it better units as a result of his work. The word "duty" is a dour one, but fortunately in the case of the physician it implies not only duty but happy privilege.

BOOK REVIEWS

Employment Psychology. The Application of Scientific Methods to the Selection, Training and Grading of Employees. By Henry C. Link, Ph.D. Cloth. Pp. 440 with appendix and index. New York: The Macmillan Company, 1919.

In the introduction to this book, Professor Thorndike concisely indicates the object of employment psychology when he says: "If there are ten applicants for a certain job there will commonly be a large advantage to the employer who selects the most fit rather than the least fit of the ten. . . . If sufficient ability and effort are expended it is possible to measure the comparative fitness of any number of men for any one given job."

In the first chapters Link shows how poorly the employment department is managed in otherwise well-organized industrial establishments: the division of *labor* has been given a great deal of attention, but the division of *laborers* is still haphazard. Modern psychology offers the mental test as one solution of the problem of selecting employees. These mental tests are carefully developed and accurately checked up; in applying them to industry, however, the psychologist must work from within out, that is, he must first study the various operations of the industry and then test his tests to see if they are significant. Examples of these tests and the results of their application to specific problems are interestingly given, and the methods by which these results were obtained are described. For example, the tests tried on male and female assemblers, on clerks, stenographers and machine operators are given, and also the correlations of the results of the tests with the actual performance of the individual. The evidence seems to be fairly and conservatively presented and convinces the reader that, in certain industries at least, much can be done by these means to fit the man to the job more quickly and accurately.

In the second part of the book, *trade tests* are discussed and described. These tests differ from the psychological tests in that they aim to test the acquired knowledge or ability which is supposed to go with a recognized trade. The information is obtained through questions or written questionnaires, and examples of such series of questions are given and criticized. The observation method of picking out employees is also taken up, and it is shown that an actual test at the machine or operation which the employee professes to understand is often the best test of all. In fact, the trend of employment psychology is to subordinate irrelevant appearances to relevant actions. Furthermore, not only the employee must be sized up but the job must be analyzed — an available man must be put into the right job — and in large concerns where one employment office does all the hiring for every shop, there are literally hundreds of varieties of jobs to be analyzed.

With all these methods of short examinations, however, no idea of the moral qualities of the individual is obtained; enthusiasm, determination, cheerfulness and reliability are still important unknown quantities. These can only be determined by long observation, for which purpose the vestibule school is invaluable. It is essentially a preliminary training school in which to observe and coach new employees; it also gives applicants an opportunity to try various kinds of work and to take their choice, besides providing a center where old employees can be renovated and unsatisfactory employees eliminated. With such a school running, there is always a reservoir of trained men to draw on, and the various shops may be kept more evenly balanced. In short, the vestibule school is almost indispensable if applicants are to be properly selected and fitted to their work.

Part III has to do with selection and retention; the methods by which men are being fired are every bit as haphazard as the methods by which they are being hired. The most satisfactory proof of a worker's fitness to continue his work is his comparative productiveness since the chief purpose of an industrial organization is to produce. Productiveness can be mathematically and impersonally measured and a periodic record kept. Moral characteristics cannot thus be recorded, but it has been found that these more elusive moral characteristics are relative rather than absolute, and depend upon the degree to which the tasks of the worker are suited to his abilities and preferences.

In Part IV under the heading *A Practical Combination of Employment Methods*, the results of this study have been compressed into a concrete plan of procedure which can serve as a guide to the employment manager who wishes to apply them.

In general the book is well written, readable and excellently arranged, with enough concrete examples to add interest and to show that the author knows whereof he speaks. The only adverse criticism is that at times the style is immature and redundant, so that the important statements are submerged and the book made unnecessarily long. The book is a pioneer in its field and is published at a time when many people are asking for concrete information on this subject. It is opportune, and we recommend it to all those who are interested in employment management as a conservative and well-balanced statement of new and interesting facts. — *Stanley Cobb.*

The Young Wage-Earner and the Problem of His Education. Essays and Reports Edited by J. J. Findlay with a Committee of the Uplands Association. Cloth. Pp. 211. London: Sidgwick and Jackson, 1918.

This book contains a collection of essays and reports of observations upon part-time education, prepared in connection with the work of the Uplands Association, a society organized to promote educational reform and to provide means of study and co-operation for those who are interested in this movement. The results of the book are mainly a reaction to the Fisher Act which, if we understand it, provides for compulsory part-time education for all

youths between the ages of 14 and 18 who are engaged in gainful occupations, this education to consist of about 300 hours of school work each year and to be exclusively day-time work.

This assertion of public control over youths during a long period and extending through the years commonly regarded as most determining for the life of the individual, appears to have impressed English educators as requiring a new interest in the theory of education as a whole, and in its relations to the economic order and social life. The essays consider these problems from several points of view, but especially in regard to the psychology of adolescence. There is an impression that this new educational demand will result in bringing to the surface new types of teachers and teaching ability, and will produce a situation in which the practical mind will have more opportunity to display itself and in which especially social qualifications and ability to direct the social life of industrial workers will play a large part. The new place of the girl in industry and the fact that the home is no longer the main controlling factor in the life of the adolescent girl become significant, and it is urged again and again that the main problem is social education — that technical education is not the most important consideration. Practicality, but not immediate application, must be the guiding principle. The new education must fit into the life of the factory worker and not merely be added to it, and there must be some re-adjustment in the education of the earlier years. Since factory labor is repressive, both physically and mentally, there is a fundamental need of education of the worker for freedom of expression. There must be mental, aesthetic and moral nurture.

Several reports are made of plans at present in operation. A school conducted by the Birmingham Education Committee provides, for girls, one session each week of three and a half hours, conducted during working hours, the time being paid for as work-time. A second session of equal length, the time thus spent not being paid for, is elected by about one-third of the workers. None of this work is immediately practical. A commercial school in a store is described, providing instruction for three grades, the supervisor of students assisting in the adjustment of the employees in the work of the establishment. Here the studies are mainly vocational, and culture somewhat incidental. Several other types of organization are described, the part-time education of clerks in Manchester, the work schools for engineers in the same city, especially devoted to the development of technical ability, and other schools, the work of which cannot be very clearly understood without reference to the local conditions. — *G. E. Partridge.*

Common Sense in Labor Management. By Neil M. Clark. Pp. 218 with appendices. New York: Harper Brothers, 1919.

The title of this book is unusually well chosen inasmuch as the subject matter is presented in a clear, convincing manner. The writer does not seem to be desirous of adding any appreciable number of new ideas to those which have been engaging our attention in connection with labor problems. His aim is rather to select and place in their appropriate setting certain ideas which appear to him to be fundamental. This form of procedure naturally involves a discussion of several phases of labor management. For this reason and because of the simple and yet clear presentation of facts, this book ought to be of particular interest, not only to those whose field is labor management but also to those whose activities bring them to the outskirts of this field.

The writer feels that the fundamental concept in the field of labor management today is that labor is not a commodity that can be bargained for as other commodities; it is a great human problem, and, regardless of the attitude of the employer, the worker never loses sight of the fact that he is an individual. In dealing with the question of industrial democracy, the writer points out that the success of any scheme does not depend primarily upon its complexity nor upon its simplicity, but rather upon the attitude of "thoroughgoing righteousness" which the management assumes.

The chapter on *Working Conditions* treats the various phases of health, safety, and sanitation problems from the standpoint of production, emphasizing that comfortable, congenial surroundings bear an important relation to efficiency. In discussing living conditions, the same idea is developed. By giving the worker a house which is attractive and of which, in many instances, he can become the owner, not only a better worker is developed but also a more stable one.

In deciding upon what wages it should pay, a company should make a careful study of conditions which determine the cost of living so that no one shall be paid less than a living wage. Above this minimum, wages should provide proper incentive and reward for special service rendered to the organization.

In discussing the *Worker's Security in the Job*, the writer points out the possibility that the seasonal character of many industries can be eliminated to a large extent, so that a permanent, reliable force of workers can be built up and retained. In many instances, the writer believes, much of the lost craft spirit can be reintroduced into industry though in a somewhat different way from that in which it previously existed. In the first place, workers can be more carefully placed according to their natural inclinations and, in the second place, many jobs can be made attractive by giving the worker more responsibility in the control of production and quality.

In the concluding chapter, *The Fallacy of Panaceas*, the writer points out that there is no *best policy* for all industrial organizations, but that for each there is probably an *individual best policy*. All policies, whether they are the simplest or whether they have many avenues of expression, must bear the stamp of a sincere desire upon the part of the management to be just in all human relations. The basis of any plan must be threefold:

"1. A fair compensation both to the worker and to the employer.

"2. A fair chance to enjoy the work in and of itself.

"3. A fair opportunity to take advantage of the better things of life — when the day's work is done." — *Charles H. Paull.*

Present-Day Applications of Psychology. With Special Reference to Industry, Education and Nervous Breakdown. By Charles S. Myers. Paper. Pp. 47. London: Methuen and Company, 1918.

This book comprises two lectures which were delivered at the Royal Institution of Great Britain and is intended to be a brief summary of present-day applications of psychology. As applied in industry, psychology has first to offer the results of the very numerous studies of muscular and mental work made in the laboratory. Upon the basis of the analysis of fatigue and work, we are enabled to proceed with some definite principles in regulating industrial operations; we also find numerous problems requiring special investigation.

Myers reports an interesting study upon a group of shovelers. (Whether this is from Muscio's work is not clear.) By experiments upon optimal weight of shovel loads, the work of the group of shovelers was so regulated as to increase the average output by nearly 270 per cent., the average earnings of the shovelers increasing 60 per cent., while the cost of the labor to the employer was reduced by 50 per cent.

By controlling the few fundamental factors in operations in which fatigue enters — fatigue, practice, incitement, spurt and settlement — we may modify to a very great extent the quality and the quantity of work produced in a given time. In one case, by the elimination of a single factor of distraction — noise — an increase in output of work was made to the extent of 25 per cent. The importance of the study of industrial fatigue is shown also by the close relation that exists between fatigue and accidents, and it has been shown that there is a greater frequency of accidents toward the end of long periods of uninterrupted work.

The study of rest periods has recently, especially during the war, led to fairly definite conclusions; it is strongly indicated that periods of work of great length should be interrupted by short periods of rest. There can be no doubt that an unbroken morning of four or five hours is uneconomical. An experiment in trench-digging in which work done continuously was compared with work done by groups of laborers in relays, allowing ten minutes of rest after each five-minute period of labor, showed that more could be accomplished by the alternation of work and rest. Experiences of a firm in Manchester have shown that, under similar conditions, the product of a properly divided fifty-one-hour week fully equalled that of a sixty-six-hour week. Similar results were found in a surgical-dressing factory in which the operation especially observed was yarn-winding. One worker produced 8 per cent. more work in 32 per cent. less hours than her competitors of equal skill, working under otherwise similar conditions.

Quite as valuable results may be derived from application of the psychology of the learning process to industrial operations. Motion-study still further extends the control over energies and products, and we may expect many results from the analytic study of movements. Estimation of individual differences, as measured with reference to occupation, and the study of children by the exact methods of the laboratory are now both fruitful and necessary. — *G. E. Partridge.*

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

A Manual of Hygiene and Sanitation. By Seneca Egbert, A.M., M.D., Professor of Hygiene, University of Pennsylvania, Formerly Professor of Hygiene, and Dean of the Medico-Chirurgical College; Sometime Major, Medical Corps, U. S. Army; Member of The American Medical Association, American Public Health Association, etc. Cloth. Pp. 554 with index. Illustrations. Philadelphia: Lea & Febiger, 1919.

British Labor Conditions and Legislation During the War. By M. B. Hammond, Professor of Economics, Ohio State University; Representative of U. S. Food Administration on the War Labor Policies Board. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 14. Edited by David Kinley, Professor of Political Economy, University of Illinois; Member of Committee of Research of the Endowment. Paper. Pp. 335 with index. New York: Oxford University Press, 1919.

Effects of the War on Money, Credit and Banking in France and in the United States. By B. M. Anderson, Jr., Ph.D. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 15. Edited by David Kinley, Professor of Political Economy, University of Illinois; Member of Committee of Research of the Endowment. Paper. Pp. 227 with index. New York: Oxford University Press, 1919.

Direct and Indirect Costs of the Great War. By Ernest L. Bogart, Professor of Economics, University of Illinois. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 24. Edited by David Kinley, Professor of Political Economy, University of Illinois and Member of Committee of Research of the Endowment. Paper. Pp. 338 with index. New York: Oxford University Press, 1919.

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THE SIGNIFICANCE AND TREATMENT OF VARICOSE VEINS*

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VARIX, or varicose veins of the legs, falls among the partly disabling diseases. In some individuals it appears to be tolerated without complaint; in others it leads to discomforts which interfere with the more strenuous occupations. It rarely is a cause of death. Among men the condition may be said to occur almost exclusively in those who are doing hard manual work, or whose occupations cause them to stand for long hours on their feet, and more particularly where both conditions are present. Among patients treated for the last six years at the Peter Bent Brigham Hospital, seventy-one men have been operated on for this disease. Of these, twelve were laborers, six were carpenters, five were machinists, four were teamsters, three were blacksmiths, and the remainder were scattered among the occupations (such as freight-handler, bricklayer, waiter, and salesman) necessitating hard work or long standing. Among women the cause of varix is almost always to be found in child-bearing. Occasionally it dates from puberty without obvious reason.

MECHANISM OF THE NORMAL VENOUS CIRCULATION

Varicose veins may be defined as surface veins which have lost their power to carry blood in the direction of the heart. The loss of this function will be better understood after a brief sketch of the mechanism by which the veins of the extremities normally carry back the used blood. All the veins of the extremities (and here we are dealing only with the legs) are furnished with many sets of bicuspid valves so arranged that the veins are divided into a series of segments in which the valves permit a flow of blood only in the direction of the heart. The arterial blood, having passed through the capillaries, is taken up by the veins, and every muscular movement tends to cause compression of the vessels, so that the blood is passed from one segment to another without the possibility of return. One has only to stand perfectly still for a long period to appreciate the discomfort caused by the failure of this muscular assistance. There is, in addition, a definite suction in the direction of the heart brought about by the movements of the heart and lungs, and there is, of course, a steady propulsion of the stream from the arterial circulation through the capillaries. The first of these influences being the most important, a breaking down of the valves is the principal cause of the establishment of varicose veins. (Figs. 1 and 2.)

THE BREAKING DOWN OF THE NORMAL MECHANISM AND ITS RESULTS

The loss of this mechanism is most readily brought about by increased intra-abdominal pressure, as for instance, when in lifting, the abdominal muscles are set, the breath is held, and the same strain is present which produces hernia. The valves break under this back pressure, further distention is brought about, the veins lengthen and become tortuous, the circulation in their walls becomes poor, and they develop into the familiar distended, sacculated, fibrous vessels so often seen among working

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people. And since the deep veins, which are well protected by their muscular surroundings, rarely if ever share in this process, we are dealing here only with the surface veins which carry probably only a comparatively small proportion of the blood returned from the legs. (Fig. 3.)

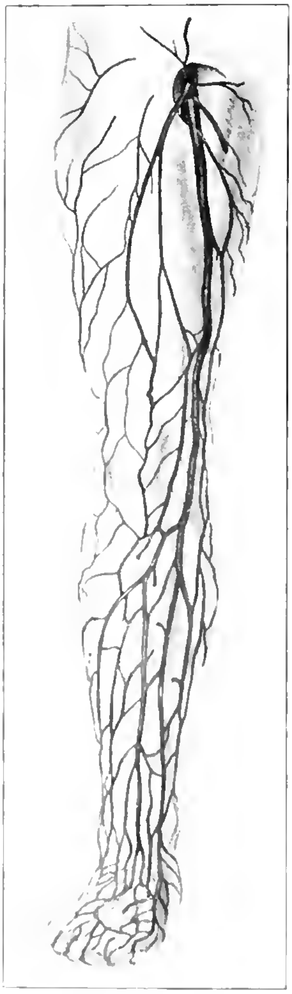

Fig. 1

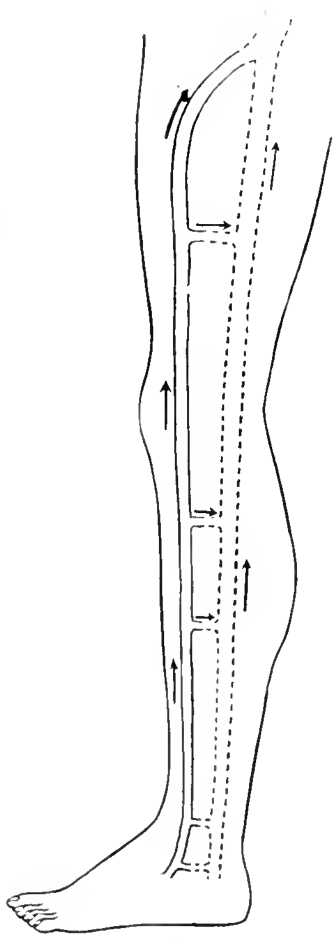

Fig. 2

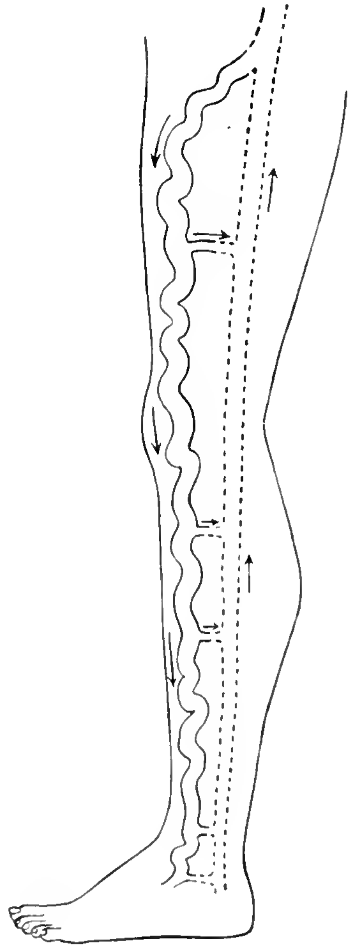

Fig. 3

Fig. 1. —The superficial veins, which may become varicose: the great or internal saphenous and its branches. The lesser saphenous which drains the back of the calf, emptying into the popliteal veins, is not shown. (*By courtesy of Surgery, Gynecology and Obstetrics, February, 1916, pp. 143–158.*)

Fig. 2. —Diagram showing normal direction of blood current in the superficial and deep systems. Perforating veins connect the two and carry blood toward the deep vessels only. (*By courtesy of Surgery, Gynecology and Obstetrics, February, 1916, pp. 143–158.*)

Fig. 3. —Diagram showing direction of blood current in varicose veins. Blood flows down the surface veins. The perforating veins drain the surface vessels. The deep veins do additional work. (*By courtesy of Surgery, Gynecology and Obstetrics, February, 1916, pp. 143–158.*)

The discomforts brought about by surface varicosity are due in part to the fact that blood has a tendency to pour down the surface veins and has to be carried away by the deep ones, so that a sort of vicious circle is established which continually throws increased work upon the latter. This, in all probability, brings about a certain amount of congestion of the muscles, and to this congestion must be attributed a great deal of the patient's feeling of heaviness and discomfort and the familiar slowing up of the action of the muscles themselves. Undoubtedly in some cases there is compensatory surface circulation outside of the great saphenous system so that the deep veins have very little additional work to do. In other instances, where the surface varicosity is very general and well developed, the overwork of the deep vessels is probably very important. Such differences as this may account for the variations in this type of discomfort experienced by different patients whose legs on superficial examination may appear much alike. Another

most annoying complaint is itching, harmless enough if it only led to the satisfaction of scratching. Unfortunately, scratching is too dangerous a pleasure to be indulged in with impunity, particularly in legs not too clean. In this connection, eczema, whether or not it may be laid to the door of the varicose veins, is the most cruel annoyance of all.

Complications

The disabling complications of varicose veins are ulcers and phlebitis. The former arise from trivial causes. Above all, lack of cleanliness is the important predisposing factor. Individuals suffering from varicose veins should be even more scrupulous in the care of their skin than ordinary individuals. It hardly requires argument to show that skin bacteria are more abundant and virulent in the absence of soap and water, and if scrupulous cleanliness could be made obligatory in the presence of varicose veins, the number of individuals disabled by complications would be enormously decreased. But often when every precaution is taken, bruises, or abrasions caused by scratching tend to heal badly, are easily infected, and give rise to obstinate ulcers. These vary tremendously in character, from the small, clean-looking sore "riding" on a surface vessel to the great foul ulcer with a tremendous leathery base which results from long neglect. I question very much whether the onset of ulcer can be foreseen and prevented. The only indication that ulcer is likely to occur is found in the areas of pigmentation, which suggest that the skin is constantly irritated and particularly poorly nourished. The presence of these pigmented areas should, I believe, be regarded as a warning that ulcers are likely to occur and in their presence operation may well be advised. (Figs. 4 and 5.)

The second complication, phlebitis, may occur at any time. While probably due primarily to infection, the clotting may appear to be clean and is often unaccompanied by any great local tenderness. At other times the clotted vein is surrounded by a very hard, tender zone. Any phlebitis calls for complete rest in bed — best in a hospital. It is always a possible source of embolism and should be regarded as a dangerous condition. The question of operating in the presence of phlebitis will be considered later.

Fig. 4. — Common type of varicose veins. On the right, the veins are shown at their natural distention. On the left, the back flow of blood down the veins is prevented by pressure on the great saphenous vein near the groin. The surface veins have previously been emptied by elevating the leg. Note the pigmented area in the lower calf suggestive of impending ulceration.

Palliative Treatment

There is no way of preventing the onset of varicose veins. Even provided that the number of those afflicted were sufficient to warrant the wearing by everyone of some support in the form of a bandage or stocking, it would be necessary to have this support applied to the thigh as well as to the lower leg, which is impracticable. However, once the condition is established, bandaging or the wearing of a supporting stocking is the only palliative treatment available. It may be said to subserve two purposes. In the first place, bandaging gives a great deal of symptomatic relief

and if properly carried out may do away with all the patient's discomforts. The word "bandaging" is used in a broad sense to apply to the use of the flannel or Benda bandage, to the elastic stocking, and to the fitted or canvass stocking. The first of these means, the flannel or Benda bandage, is under the control of the patient himself. He must learn to bandage his legs so as to attain comfort and must acquire this art from some physician. The second means, the elastic stocking, is rather expensive and is out of the reach of the ordinary patient. It is quite effective when the stocking is new, but is on the whole unsatisfactory, especially for working men. The third means, the fitted or canvass stocking, is quite practicable. At the Peter Bent Brigham Hospital we have made use, in the Out-Door Department, of the so-called Corliss stocking. The measurements are easy to take and, on the whole, these stockings fit well. They have to be laced up every morning and, if well fitted, are quite satisfactory; if they fit badly they are worse than useless. It has proved a help to have some kind of rib put into the inner and outer sides to keep the stockings from wrinkling. Any form of bandaging, if successful, not only promotes the patient's comfort but probably tends to prevent the onset of ulcers, since the bandage improves the surface circulation and the condition of the skin.

Bandages are again useful in the treatment of ulcer, but here their application must be carried out by a physician. It has been found that the most satisfactory arrangement is the so-called "jelly" bandage, which is nothing more than gauze permeated with a paste originally devised by Unna. Various unimportant modifications of this paste have been made. The formula for the paste is herewith given:

Zinc Oxide	10 gm.
Gelatin	40 gm.
Glycerin	120 c. c.
Water	150 c. c.

Dissolve the gelatin in hot water by heating. Mix the zinc oxide with the glycerin. Put all ingredients together and let stand until hard, occasionally stirring.

The method of application is as follows. The leg, which has been kept elevated for some time, is painted from the toes to a point below the knee with the heated paste. A single layer of narrow gauze bandage is then applied firmly without creases. Upon this a second layer of paste is painted, and in this way three or four layers of bandage impregnated with the paste are put on and allowed to dry. When dried, the jelly bandage is slightly flexible, smooth, and very durable. It may often be left on for several weeks. The ulcer can be treated without removing the bandage by cutting out a window and by making local applications as often as is advisable. The window is then covered with a sterile dressing, which is bandaged into place. In this way many ulcers can be healed, and it has been my custom to apply such bandages to patients leaving the hospital after operation for ulcer. In general, these bandages are very comfortable and although their application requires a certain painstaking skill, once a doctor or nurse is familiar with their use, they are a very simple and satisfactory therapeutic agent.

Diagnosis

The diagnosis of varicose veins is often very simple. No one can mistake the condition in the presence of dilated, tortuous sclerosed surface vessels. On the other hand, it is important to distinguish between large veins which are not completely varicose and the fully developed condition, as well as to discover the presence of true varicose vessels which are not visible upon the skin. The test which distinguishes true varicose veins was originated by Trendelenburg. The theory of the test is that varicose veins have no valves and that blood flows down them quite as well as up. Therefore, if the leg is elevated above the level of the body and is then lowered, the blood is first emptied out of the superficial vessels and flows into them rapidly upon lowering the leg. This can conveniently be done by placing the patient in a chair, tipping the chair backwards with the patient's leg elevated, and then placing the patient quickly on his feet. In cases of true varicosity the surface veins fill with a rush, which is sometimes almost a palpable shock. The refinements of this test are quite obvious; for instance, if the leg is emptied of blood and a constriction only firm enough to block the surface veins is applied to the upper thigh, the veins below the constriction can no longer fill from above and remain empty until filled by the normal arterial circulation through the capillaries. This requires a considerable

time and in many cases a large, sacculated vessel will remain empty, or very loosely filled, for perhaps a minute until the constriction is released, when it becomes tense at once. This refinement or, as it might be called, "constriction test" not only confirms the simple Trendelenburg test but demonstrates any leaking of blood, which should not ordinarily take place, from the deep veins to the surface. In other words, the simple Trendelenburg test demonstrates that there is a back flow of blood down the surface veins and that they are completely valveless. If now, with the constriction applied, the leg is returned to the ground and the surface veins fill rapidly below the constriction, there is not only a complete surface varicosity but there is also a valvelessness of the veins which perforate from the surface to the deep veins and which normally act only as a sort of overflow or safety vent for the former. The fact that these perforating vessels allow blood to pass from the deep veins towards the surface is of particular interest in connection with ulcer, for if in the presence of ulcer the varicosity of these perforating vessels is proved, it is generally advisable to excise the ulcer, since a leaking perforator may be directly beneath it. The same test will also discover the presence of a varicose condition in the lesser saphenous vein which empties into the popliteal space and drains the back and outer side of the calf.

FIG. 5. — Case I. (J. J. K 2292) Varicose veins and ulcers of several years' standing in well-developed pigmented areas tributary to immense varicose veins. (*By courtesy of Surgery, Gynecology and Obstetrics, March, 1917, pp. 300–311.*)

FIG. 6. — (4060). Typical ulcers of postphlebitic varix. Veins almost unnoticeable. Compare with Figure 5 (*By courtesy of Surgery, Gynecology and Obstetrics, March, 1917, pp. 300–311.*)

If the Trendelenburg test is not obviously positive, there is some question whether apparently varicose vessels should be operated on, since the veins may still be doing some useful work and their removal might suddenly increase the work of the deep veins and bring about swelling of the leg until such time as the circulation becomes readjusted. In other words, operation should be delayed until the surface varicosity is complete and compensatory circulation, in so far as it can be, is established.

As to the condition in which varicose veins are present but are not visible, the diagnosis depends for the most part upon a history of a previous phlebitis. A phlebitis such as complicates typhoid leaves a very small, thick-walled, straight, and often

invisible vein to which may be tributary a few thin-walled, very superficial tortuous vessels. By using these superficial vessels as an index, the Trendelenburg test can be demonstrated almost as well as in the presence of the familiar enormously dilated veins, and with a history of phlebitis gives the diagnosis. Such a condition is difficult to cure and operations can hardly be expected to restore the patient to his former usefulness, but they must be undertaken as a treatment for the ulcers which usually call attention to the underlying disease. In operating upon the ulcers the veins as well must be removed. This condition, which is frequently mistaken for syphilis, is, fortunately, rare. (Fig. 6.)

Operative Treatment

The operative treatment of varicose veins consists in the removal of the dilated surface vessels from the groin down. To be efficient it must permanently break the column of blood between the abdominal vessels, which have no valves, and the surface capillaries. If it accomplishes this, it permits the restoration of a considerable amount of surface venous circulation through small veins which have not been distended by the stagnation in the main venous channels. It does away with stagnant blood on the surface — blood which keeps pouring down the distended vessels and increases the work of the still normal deep veins. It thus removes veins which are worse than useless and affords real comfort, but as it does not restore the original surface circulation, it cannot be said to return the patient to an absolutely normal condition. In other words, a perfect surgical result may not make the leg as good as new.

It is not the intention of the writer to deal with the technicalities of operation, but rather with a few principles which surgeons should keep in mind if their operations are to be even as successful as indicated above. First, the great saphenous vein, which originates in the femoral vein and passes down the inner face of the thigh to be distributed to the lower leg, must be completely eradicated at its upper end so that new varicose connections with any remaining varicose branches below cannot become established — that is to say, it must be tied off at the saphenous opening, any branches entering its stump from above must be divided, and it must be thoroughly removed in the thigh. Probably the excision of its more obviously distended principal branches in the calf is less important. Their removal is more satisfactory to the patient's feelings, but since it is often impossible to do away with all of them and since the back pressure from above is really the cause of the patient's discomfort, their removal is far less important than the thorough eradication of the saphenous vein above.

Second, by whatever method the veins are removed, the healing of the operative wounds must be perfect. There must be no sloughing of skin nor any inflammatory reaction. This requires the most gentle handling of tissues in operating, and it is always better to remove the veins from beneath full thickness flaps of skin and fat than to attempt to follow a tortuous vessel from the surface. I am convinced that unless operative wounds heal in a perfectly reactionless way, the percentage of operative failures is bound to be greatly increased.

Third, ulcers must be dealt with in such a way that they cannot recur. This is perhaps the requirement the most difficult of fulfillment. When the ulcer "rides" upon a vein (as is usually the case), the removal of the vein is almost necessarily curative without any direct attack upon the ulcer itself. If, however, the ulcer is of such long standing and so surrounded by scar tissue that even after the removal of the veins the circulation beneath it is bound to be poor, it is better to excise the ulcer without regard to its size, even down to bone or muscle, and to skin-graft the defect.

Finally, when phlebitis is present, the difficulties not only of operating but of the decision to operate are intensified. In early acute phlebitis it is probably a safe rule to delay operation when the thrombosis has extended into the upper thigh. Until organization of the clot reduces the danger of detaching an embolus by operative handling, the patient should be kept quiet in bed. Later, since thrombosis and organization appear always to be followed by re-establishment of the circulation, the standard excision of the veins should be carried out. And since the vitality of the tissues is even lower than before, the operative technique must be particularly perfect.

If thrombosis is confined to the calf — gentle palpation easily determines this — operation may be performed at once, for

high division of the great saphenous vein will then block any possible embolism. Care must be exercised in handling the thrombosed region and in estimating the healing qualities of the tissues in the neighborhood of the phlebitis. It is often advantageous to remove a narrow block of skin with the thrombosed vessels.

Operations carried out on these principles have, on the whole, proved very satisfactory and I believe that the bad name carried by the usual run of operations for varicose veins should not be deserved. There is one small class of varices, however, in which operative failure is not uncommon. This includes the varicose veins which develop following the phlebitis of acute diseases, such as typhoid. This phlebitis really amounts to a general infection of all the superficial tissues of the calf. It leaves a normal looking leg, the veins themselves thick-walled, small and invisible, but ulcers appear early, are very obstinate and painful, and their cure is exceedingly difficult. On the other hand, the legs which present immense dilated surface varicosity, diffuse pigmentation and ulcers tributary to "lakes" of blood are usually susceptible of a satisfying operative cure. For example: the subject of Figure 6, a post-phlebitic case, was never completely cured by operation: but the subject of Figure 5, an advanced varix of the common type, had worked ever since operation as a longshoreman and was well two years after operation. (Fig. 7.)

Results

The following list of male patients, taken in series from the earliest cases treated in the hospital up to the last cases in whom the result is known, will give an idea not only of the difficulty of following up patients, but also of the successes and failures. In general, the patient's own statement as to success or failure has been accepted without regard to the opinion of those who have examined him. In this list there will be found to be forty-eight cases. Seventeen have not been traced; eighteen may be considered to be completely successful; eight have been partially successful; and five have been failures.

No. 115. — Machinist: Able to resume work; well two years after operation. *Success.*

No. 125. — Freight-handler: Cannot be traced.

No. 215. — Longshoreman: Able to resume work; well two and a half years after operation. *Success.*

No. 246. — Machinist: Cannot be traced.

No. 419. — Freight-handler: Returned to work after first operation; five months later entered hospital again because ulcers had not all healed; result of second operation not known. *Partially successful.*

No. 533. — Cook: Has been subjected to a number of operations since the original; great general improvement; not cured. *Partially successful.*

FIG. 7. — (J. J. K. 2292). Same patient shown in Figure 5. One and one-half years after operation. The oblique scars in the groins barely show. Note that some veins in the lower leg still show. No discomfort or return of ulcers. (*By courtesy of Surgery, Gynecology and Obstetrics, March, 1917, pp. 300–311.*)

No. 685. — Laborer: Recurrence of ulcer without discomfort; refuses further treatment. *Partially successful.*

No. 785. — Barber: Well since operation; two years later reported cured. *Success.*

No. 857. — Laborer: Well for a year after operation; mild recurrence of symptoms. *Partially successful.*

No. 1256. — Laborer: Report two years later; said to be drinking; probably not well; not examined. *Failure.*

No. 1382. — Laborer: Cannot be traced.

No. 1433. — Laborer: Subsequently died of tuberculosis. *Result not known.*

No. 1757. — Machinist: Well since operation; three years later reported cured. *Success.*

No. 1950. — Laborer: Cannot be traced.

No. 2007. — Stationary fireman: First operation, complete cure and returned to work for two years;

second operation (other leg), death from embolism. *Failure.*

No. 2053. — Shoemaker (foreman): Well since operation; two years later reported cured. *Success.*

No. 2771. — Bricklayer: Reports one year later; does not consider himself improved; not seen. *Failure.*

No. 2911. — Railroad man: Cannot be traced.

No. 2995. — Cook: Well since operation; two years later reported cured. *Success.*

No. 3245. — Teamster: Cannot be traced.

No. 3511. — Fruit-dealer: Two years later reported to be well. *Success.*

No. 3542. — Tailor's pressman: Five months after operation does not consider himself improved. *Failure.*

No. 3757. — Laborer: One year after operation reports himself as well. *Success.*

No. 3819. — Hospital orderly: Cannot be traced.

No. 3926. — Textile-worker: Cannot be traced.

No. 3981. — Teamster: Unable to do heavy work; much improved. *Partially successful.*

No. 4106. — Accountant: Well after discharge; four months later reported cured; no subsequent note. *Success.*

No. 4329. — Stationary fireman: Re-operated on. *Failure.*

No. 4060. — Bricklayer: Cannot be traced; known to be hard drinker.

No. 4385. — Shoe stitcher: Well since operation; two years later reported cured; "does a great deal of heavy lifting." *Success.*

No. 3541. — Blacksmith: Reported working at his previous occupation one and a half years after discharge; no note of local condition. *Success.*

No. 4779. — Driver's helper: Well after operation; two years later reported cured. *Success.*

No. 5121. — Carpenter: Cannot be traced.

No. 5262. — Carpenter: Cannot be traced.

No. 5273. — Carpenter: Well since operation; two years later reported cured. *Success.*

No. 5962. — Teamster: Cannot be traced.

No. 6392. — Pipe-fitter: Cannot be traced.

No. 6404. — Piano-worker: Has been seen subsequent to leaving hospital and makes no mention of his legs. *Success.*

No. 6518. — Piano-worker: Has worked hard since operation, sometimes eighteen hours at a stretch; two years later reported well. *Success.*

No. 4942. — Longshoreman: Cannot be traced.

No. 6652. — Chauffeur: Cannot be traced.

No. 7193. — Iron-worker: Well since operation; two years later reported cured. *Success.*

No. 7107. — Piano-worker: Cannot be traced.

No. 3131. — Laborer: Twice operated; well after second operation; two years later reported cured. *Success.*

No. 7826. — Soda-fountain clerk: Two years after operation has some dilated veins over front of leg; wears bandage. *Partially successful.*

No. 7248. — Restaurant proprietor: Well since operation; two years later reported cured. *Success.*

No. 8442. — Shipper: Cannot be traced.

No. 7940. — Salesman: Two years later reports leg healed up but feels he was never cured; wears an elastic stocking. *Partially successful.*

Conclusions

1. Varicose veins in males occur among those whose occupations entail hard manual labor and long hours of standing.

2. The palliative treatment of varicose veins is only moderately satisfactory and depends for its success principally upon the co-operation and conscientiousness of the individual.

3. Disabling complications, ulcer and phlebitis, may, to a limited extent, be foreseen and prevented by cleanliness and palliative treatment. If they become recurrent or constant factors, operation is to be advised.

4. Operation for varicose veins, if properly performed, is usually curative. The very nature of the disease may, however, cause a theoretically perfect operation to fail to make the patient "as good as new." And the more advanced and complicated the disease, the less complete is the postoperative return to normal.

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THE INDUSTRIAL DENTAL CLINIC FROM THE STANDPOINT OF THE INDUSTRIAL SURGEON*

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A PRELIMINARY presentation of this subject was first given in a paper read before the Health Section of the National Safety Council at the fall meeting held in St. Louis in 1918. The object of this preliminary report was to foster interest in industrial dental work in conjunction with industrial hygiene. Up to that time, it seemed that men engaged in this branch of industrial work had neglected the systematic study of cases in their dispensaries which had come up either for examination or for treatment, and had thereby missed many opportunities for doing the most good for their workers. In fact, at the majority of clinics it still seems to be the practice merely to fill out record cards, to list the total number of persons examined, treated or rejected, and to make no attempt to follow up the cases or to diminish the number requiring treatment by a careful study of the records and analyses of the underlying causes responsible for existing disabilities. Only occasionally is a note made of the transfer of a case to a doctor or to a hospital for treatment, and even more rarely do we find a report of the result of such treatment on the original history card.

The purpose of presenting this important subject at this time is the thought that it may stimulate a more careful survey of the field and may ultimately bring about a more exhaustive and scientific study of the individual records, and closer co-operation between the industrial surgeon, the industrial dentist and the industrial nurse.

We are familiar with the extraordinary frequency with which oral sepsis is overlooked alike by all concerned — physician, patient, surgeon and even the dentist. It is not the purpose of this paper to point out how common a cause of disease mouth infection is, how great its effects, or how often it is lightly regarded. The special interest of dental disease arises from the fact that dental cario-necrosis is the most common and most prevalent infection in the body and that this infection is mixed in character, including not only harmless organisms but also all the pathogenic organisms known to bacteriologists.

The modern industrial clinic must include the services of a dental surgeon. Our experience has but confirmed our belief that among young people engaged in factory work the conditions in the mouth are of greater importance and of more serious import, in so far as impaired usefulness is concerned, than functional disorders of the circulatory system or of the kidneys. Also it is important that contact between employee, physician and dentist should be established with the preliminary physical examination of the applicant for employment.

An examination of the oral cavity should be a part of the general physical examination of each new employee. In fact, conditions in the mouth may serve to show that the applicant as soon as employed may become a liability rather than an asset. In our own dispensaries the examining physician and dentist are on duty at the same time and they occupy, so far as possible, adjoining rooms and the record cards are filed in the same envelope. Frequent consultations are the rule rather than the exception. A not unusual incident, which occurred in one of our dispensaries a short time ago, will illustrate the value of this combined examination. The dentist, in his preliminary examination, called the examining physician's attention to the condition of the applicant's mouth. The findings observed in the oral cavity led to a diagnosis of syphilis in the secondary stage, and a most dangerous menace to the health of the working body was excluded. The removal at this preliminary examination of a decayed tooth, which is almost sure to ache at any moment, is not to be overlooked. Cases of toothache have caused new employees either to quit or to lose time within the first few days of their employment.

Of the well-conducted dental clinics in the many industrial organizations in the

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United States, most have been established because of the demand of the physician in charge of the medical department that he be given this additional help in his work. From the standpoint of the industrial surgeon, therefore, the dental clinic is an absolute necessity. Without it his work must be regarded as incomplete and of necessity unsatisfactory. After an experience of over two years of this close relationship between the dental and medical clinics, we realize that intelligent co-operation between the dentist and doctor leads not only to the improved physical well-being of the individual employee, but also to the increased self-respect which a clean, attractive mouth gives to an individual. This in turn has a distinct bearing on increased morale throughout the working force.

The typical cases benefited by strict attention to oral hygiene are of such frequent occurrence and the causes so commonly recognized that it would seem superfluous at this time to detail any considerable number of such cases. However, from the viewpoint of economy of time a few rather unusual selections may perhaps be of interest. The head of one of our departments, under systematic treatment for diabetes, can be kept sugar-free only so long as his mouth is in perfect condition. The pyorrhea and general septic conditions of the mouth which so often accompany diabetes are particularly troublesome. In this instance, the neglect of careful prophylactic measures in the mouth for but a few days results invariably in the reappearance of sugar. A sufficient number of cases of fainting from no apparent cause, which have been cleared up as a result of careful oral prophylaxis, have been observed during the past two years to convince us that oral sepsis is at least one of the leading factors in the occurrence of this annoying and often disorganizing accident. Cases of multiple arthritis and of digestive disorders that have been relieved by elimination of septic foci in the mouth have been so numerous that their treatment by this means has become an established practice.

From our experience during the past two years, therefore, we have arrived at the conclusion that the relation of the industrial dentist to the medical department should be that of the industrial dental hygienist, that it is his duty to eliminate sources of infection in the mouth as regularly and as thoroughly as a sanitary engineer banishes such hazards from our building. His main functions are to clean and to instruct rather than to devote his time to the more routine dental operations, and to assist the medical department in its big campaign of preventative work.

To do the best work the dental dispensary must be thoroughly equipped. Much time and thought have been lavished during the past few years upon a careful selection of the equipment for medical and surgical aid in certain industrial clinics. On the other hand, other clinics have often been supplied with second-hand equipment, which not only seriously hampered the resident dentist's efforts to do thorough work but also gave the patient a false impression of modern dental practice. Remembering, then, that this work is largely preventative and educational, it necessarily follows that the equipment should be of the best not only in workmanship but in appearance. In addition to the usual equipment of a modern dental office, we have installed an X-ray apparatus of the latest design. This has enabled us to increase the value of our work by at least 100 per cent. Our collection of dental films has added greatly to the store of knowledge accumulated in both medical and dental clinics. The value of this work is apparent from the fact that in the past six months several factory managers have practically demanded increased service in the dental clinics, so that at present the aggregate number of hours is about equal in both medical and dental dispensaries.

Another point of contact between the medical and dental work in our industrial clinics which is rather unusual is the fact that many of our doctors and dentists are engaged in joint research work. From the result of their combined endeavors we expect much. We believe that this research will benefit first of all the workers themselves. By the knowledge thus gained workers will be kept more healthy and more contented, and their productivity and earning power will thereby increase. The company will be the gainer because of lessened absences and increased morale.

Before concluding, however, we would like to emphasize the fact that the teeth are not always the cause of arthritis; that the teeth are not the only cause of dis-

ordered stomach, nor the sole cause of anemia. Too often the mistake has been made by the over-zealous to attach to mouth infection, particularly of the teeth and gums, an exaggerated and, at times, an absurd importance as a causative factor in constitutional diseases. But this fact only emphasizes the great importance and the inestimable value of a complete clinic in which the patient — in this case our employee — may have the benefit of various opinions as to the nature of his illness and the steps which should be taken to restore him to his former health and usefulness.

CHARLES TURNER THACKRAH *

A Pioneer in Industrial Hygiene

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IN the controversies which have centred on the modern factory system, the student can readily distinguish, I think, three periods in which a fresh, distinct appeal was made to the mind of the thinking public on the score of health. The first period — the one in which Thackrah lived — was much the longest, extending over about half a century, from before 1800 to 1850, and the controversies which occurred during it were excited by concern at the excessively long hours worked by young children and the extreme instances of fatigue among them. Inquiry into these long hours disclosed well-nigh unbelievable facts. One of the witnesses says:

"The hours of labour at that (worsted spinning) mill were from 5 in the morning till 8 at night, with an interval for rest and refreshment of thirty minutes at noon; there was no time for rest and refreshment in the afternoon. We had to eat our meals as we could, standing or otherwise. I had fourteen and a half hours' actual labor when 7 years of age; the wages I then received were two shillings and sixpence per week. I attended to what are called the throstle machines; this I did for two years and a half, and then I went to the steam looms for half a year. In that mill there were about fifty children, of about the same age as I was. These children were often sick and poorly. There were always perhaps half a dozen regularly that were ill because of excessive labour. We began to grow drowsy and sleepy about 3 o'clock, and grew worse and worse, and it came to be very bad towards 6 and 7. I had still to labour on. There were three overlookers; there was a head overlooker, and then there was one man kept to grease the machines, and then there was one kept on purpose to strap. Strapping was the means by which the children were kept at work. It was the main business of one of the overlookers to strap the children up to this excessive labour — the same as strapping a restive horse that has fallen down and will not get up. This was the practice day by day. The children were not capable of performing the amount of labour that was exacted from them without perpetual cruelty. I had at that time, similarly occupied, a brother and sister. I cannot say how old my sister was when she began work in the mill, but my brother John was 7. They were often sick; my brother John died three years ago — he was then 16 years and 8 months old. My mother and the medical attendants were of the opinion that my brother died from working such long hours, and that it had been brought about by the factory."

Another says:

"I am now 16 years of age. I have been employed in piecing at a worsted mill. The hours of labour were from six in the morning to seven, half past seven and eight at night, half an hour was allowed at noon for dinner — not any time was allowed for breakfast or 'drinking.' I entered the mill at 9 years of age; my father was obliged to send me to the mill in order to keep me. If we are higher than the frames we have to bend our bodies and our legs — so. (Here the witness showed the position in which he worked.) I was a healthy and strong boy before I went to the mill. I had worked about a year for those long hours before I found my limbs begin to fail. The failing came on with great pain in my legs and knees; I felt very much fatigued towards the end of those days — then the overlooker beat me up to my work. I have been beaten till I was black and blue in my face, and have had my ears torn. I was beaten because I had mixed a few empty bobbins, having not any place to put them into separate. I was generally beaten most at the end of the day, when I grew tired and fatigued. In the morning I felt stiff, very stark, indeed; I was beaten in the morning as well, but not so much as towards the latter end of the day. I continued to attend the mill after my limbs began to fail. After I became deformed, I did not get on so well with my work as I could before. I got less in height. I cannot exactly say how tall I am now. I have fallen several inches in height. I had to stand thirteen or fourteen hours a day frequently, and was constantly engaged as I have described. (The witness, at the request of the Committee, exhibited his limbs, and they appeared to be exceedingly crooked.) I was perfectly straight before I entered upon this labour. There were other boys deformed in the same way."

In the controversies over this period the names of Percival, Owen, Oastler, Sadler, Shaftesbury, and Thackrah are household words. As a result of outside pressure from men such as these, before 1850 the hours were limited to ten a day, and of children under 11 to the same hours on alternate days, or half time, with compulsory school attendance.

Charles Turner Thackrah's title to fame rests on his little volume of 124 pages, published in 1831, "The Effects of the Principal Arts, Trades and Professions, and of Civic States and Habits of Living, on

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Health and Longevity, with a Particular Reference to the Trades and Manufactures of Leeds, and Suggestions for the Removal of Many of the Agents which Produce Disease and Shorten the Duration of Life." The conditions which he described as to employment of children and hours of labor focussed attention on the subject and led up to subsequent legislation.

Thackrah, we learn from the short biographical memoir of him by Dr. H. Y. Whytehead prefixed to his "Inquiry into the Nature and Properties of the Blood," was born in 1795. When 16 years old he was apprenticed to a surgeon in Leeds and filled up his spare time in voracious reading of works on medicine, history, and general knowledge. In 1814 he became a pupil at the Leeds Infirmary. The following two years were spent at Guy's Hospital where he came under the influence of Sir Astley Cooper. In his diary, written at this time, he states that his usual hours of study were from 7 A.M. until 11.30 P.M. In 1817 he started in practice in Leeds on his own account.

Thackrah's health, even at this time, was impaired by debility, the result of a chronic intestinal affection which never entirely left him. This ill health early in life made his outlook on life unusually sombre, as may be gathered from a letter written about this time: "On a temperament like mine, naturally melancholic, with feelings naturally keen — at times, alas! painfully acute — the common trials and disappointments of life produce an effect which is unknown to a man of less sensibility."

In 1818 he became town's surgeon and in the following year, at the request of the Committee of the Leeds Workhouse, he drew up a report on the miserable state of the inferior class of lodging houses. Although it is nowhere mentioned in the biographical sketch referred to, I derive pleasure from the thought, suggested by a paragraph in the autobiography of Robert Owen, that Thackrah owed his bent towards preventive medicine to his acquaintance with this greatest of factory reformers. Owen describes how, in 1814, he visited Leeds at the invitation of this same Workhouse Committee, to explain the methods adopted by him at the New Lanark Mills. If Thackrah, then an impressionable youth of 19, met Owen, we can readily imagine what an effect Owen's personality would have had upon him. About the year 1824, Thackrah commenced his inquiries into the effects of various manufacturing processes upon the health of artisans. In 1831 he joined other members of his profession in establishing the Leeds School of Medicine.

"The first edition of 'The Effects of Arts, Trades and Professions on Health,'" says his biographer, "experienced a reception equally favorable from the profession and the public in general. The impression was speedily disposed of and a new and improved edition was issued in the following year." About this time Thackrah visited Newcastle and Gateshead during the cholera epidemic and, subsequently, until his death from tubercular disease in 1833 — when only 37 years of age — he gave every spare moment to preparing a new edition of his work on the blood. He seems to have realized how short his life would be, and determined to make it crowded.

Whytehead concludes his sketch by illustrating Thackrah's views and feelings from one of his unpublished lectures:

> "Is the fervour of youth to be wholly expended in the accumulation of wealth? . . . Are there no noble objects for your ambition? Why should you not be Harveys, Hallers, and Hunters? . . . Why not emulate the examples of Hewson, Dessault, and Bichat? Soaring above their professional associates, deriding the attacks of envy, unbroken by anxiety and toil, they held on their course of glory. They all died at an early age; but their youthful studies brought an honour which the maturer efforts of their envious competitors could never attain. Their names are engraven in the temple of fame."

And elsewhere he says, "I shall have one satisfaction, that my remembrance will not perish."

In his "English Sanitary Institutions," Sir John Simon refers to Thackrah's book as one of the new momenta in modern preventive medicine comparable with the work of Jenner.

> "Not less meritorious than the assiduity and the care for truth with which he collected his facts, were the unprejudiced good sense and moderation with which he weighed them, and the service thus rendered by Thackrah deserves grateful recognition. By his eminently trustworthy book, he . . . made it a matter of common knowledge, and of State responsibility, that, with certain of our chief industries, special influences, often of an evidently removable kind, are apt to be associated, which, if permitted to remain, give painful disease and premature disablement or death to the employed person."

As is to be expected, in view of the different times in which they lived, there is an enormous difference in the attitude of mind with which Thackrah and Bernardius Ramazzini (Professor of Medicine at Modena and afterwards at Padua, and a pioneer in industrial hygiene who antedated Thackrah) approached their subjects, although the actual industries and occupations described are very much the same. Ramazzini's book on the "Diseases of Tradesmen" was published towards the end of the seventeenth century — just about 130 years before Thackrah's. When Ramazzini is dealing with the classical symptoms of mercurial tremor in mercurial gilders and workers in cinnabar mines, of lead palsy and lead cachexia among potters or painters, and fibroid phthisis among stone masons, his brief graphic description to be read in Dr. James' translation made in 1700 cannot be bettered. But amusement mainly results now from its perusal because of its extraordinary wealth in gossip, old-wives' tales and references, relevant and irrelevant (chiefly the latter), culled from classical and mediaeval writers on medicine.

Sydenham was almost an exact contemporary of Ramazzini, and it was no doubt the reading of such works as that on "The Diseases of Tradesmen" which led him to say in reference to his own book on "A Method of Curing Fevers" that it was "neither vast in bulk, nor stuffed out with the spoils of former authors." Ramazzini trusted his own knowledge very little and was content so long as he had any tag on which to hang a quotation. Nor was he, apparently, able to distinguish between an offensive and a dangerous trade. To swell out his volume his list of tradesmen besides those already mentioned, such as dyers, tanners, tobacconists, brewers, bakers, millers, washerwomen, flax, hemp and silk hecklers, printers, etc., is extended so as to include apothecaries, doctors, sewer men, undertakers, midwives, nurses, fishermen, sitting Jews, couriers grooms, porters, and the effects of standing and sedentary work. His methods of treatment are those of the Middle Ages.

Thackrah, on the other hand, was a thorough anatomist, and well versed in methods of clinical diagnosis. He classifies professions admirably into: (1) Operatives, subdivided into occupations carried on (a) in the open air, (b) in a confined atmosphere, and occupations exposed (c) to dusts, odors, or gaseous inhalations, (d) to moisture, and (e) to high temperatures; (2) Dealers; (3) Merchants; (4) Professional Classes. He concludes with remarks on accidents from machinery, deformity, intemperance, and remedies for the physical evils of our civil state. We may think now that he approaches his subject with undue sententiousness, but that is characteristic of the writing of the time.

It is wonderful, too, what use Thackrah makes of the material at his disposal in Leeds — material abundant, certainly, as regards work carried on in cloth mills, but scanty as regards important industries in which lead, arsenic, or mercury was used. Wool-sorter's disease was, of course, unrecognized, although reference is made to the annoyance caused by the lime used in separating the fleece from the skin. Had he in mind, I wonder, African boxwood, the subject of recent interesting inquiry, when he wrote that cabinet makers suffer when they see African wood, which "produces sneezing, headache, sickness and sometimes vomiting?" Of dusty occupations he specially singles out workers in flax, and his detailed results of auscultation and percussion of the chests of persons still employed at their work, showing chronic bronchitis, emphysema and, in some cases, added tuberculous infection, can still be read with profit. "The coughs of the persons waiting to be examined were," he says, "so troublesome as continually to interrupt and confuse the exploration of the stethoscope." He is not led away as Ramazzini was into believing that offensive trades must necessarily be injurious. On the contrary, as the result of his inquiries he classes as directly or indirectly beneficial the animal exhalations to which glue makers, tanners, tallow-chandlers, leather dressers, grooms, etc., are exposed.

In the light of recent work by Haldane and the Humidity Committee, Thackrah's study of the effects of high temperatures and exposure to steam is eminently reasonable, and he is unable to subscribe to the conclusions that exposure to these influences is a potent cause of illnesses, such as rheumatism, pulmonary disease, or even catarrh. Discussing his findings, he says:

"Anyone who is disposed to repeat the investigation must not be content with the loose statements of thoughtless and prejudiced workmen. He must ask the most intelligent . . . less for their opinions,

than for their *observations* — their own personal knowledge."

But equally incisive is his criticism of the methods pursued in the physical education of the young, especially of girls. Thackrah could not fail to be deeply impressed with the evils of child labor in unwholesome surroundings. After remarking that substitution of children for adults in flax mills produces no apparent and immediate evil, because when 13 or 14 they usually change their employment, the doubt is expressed of whether even then they escape ultimate injury to the lungs. He describes their condition thus:

"Children from 7 to 15 years of age go to work at half-past five in the morning, and leave at seven in the evening — or at half-past six, and leave at eight — and thus spend twelve hours a day, for five or six years, in an atmosphere of flax dust."

And later on applying his argument generally he says:

"The employment of young children in any labour is wrong. The term of physical growth ought not to be a term of physical exertion. Light and varied motions should be the only effort, — motions excited by the will, not by the task-master, — the run and the leap of a buoyant and unshackled spirit. How different the scene in a manufacturing district! No man of humanity can reflect without distress on the state of thousands of children, many from 6 to 7 years of age, roused from their beds at an early hour, hurried to the mills, and kept there, with the interval of only forty minutes, till a late hour at night; kept, moreover, in an atmosphere impure, not only as the air of a town, not only as defective in ventilation, but as loaded also with noxious dust. Health! cleanliness! mental improvement! How are they regarded? Recreation is out of the question. There is scarcely time for meals. The very period of sleep, so necessary for the young, is too often abridged. Nay, children are sometimes worked even in the night."

The sanity of his judgment prevents his being led into denunciation of employers for the conditions. His condemnation is directed against the way in which a temporary expedient to encroach on working hours was allowed to develop into a permanent system. Thus, he says:

"The duration of labour is the opprobium, rather of our manufacturing system, than of individuals. The masters with whom I have conversed are men of humanity, and willing, I believe, to adopt any practicable proposal to amend the health, and to improve the state of their workpeople. But they are scarcely conscious of the extent of mischief. We underrate evils to which we are accustomed. The diminution of the intervals of work has been a gradual encroachment. Formerly an hour was allowed for dinner; but one great manufacturer, pressed by his engagements, wished his workpeople to return five minutes sooner. This abridgment was promptly adopted at other mills. Five minutes led to ten. It was found also that breakfast and 'drinking' (afternoon meal) might be taken while the people were at work. Time was thus saved; more work was done; and the manufactured article consequently could be offered at a less price. If one house offered it at a lower rate, all other houses, to compete in the market, were obliged to use similar means. . . . A legislative enactment is the only remedy for this, as well as the other great opprobium of our manufactures. Were a Bill drawn up to limit the duration of labour, and prevent the improper employment of children, I feel assured that it would be well supported by petitions, not only from the public, but also from the masters themselves."

The enormous strides since made in the removal of dust by fan ventilation were foreshadowed in a suggestion of Thackrah's:

"Let channels, about a foot in breadth, be made in the floors, each with one end opening into the room and the other outside of the building. Over the former let a light broad wheel, attached to the machinery, be made to revolve rapidly. A current of air will thus be produced, and this entering the channel will draw down the greater part of the dust, and carry it out of the building. If the plan succeed in the flax mill, it would avail also for removing the dust of corn and malt-mills, indeed, of all the manufactures, which affect the lungs by mechanical irritation."

I believe Thackrah's early death retarded the progress of industrial medicine and surgery and the amelioration of conditions of employment for half a century. Had he lived, his clinical knowledge and experience would have given prominence in legislation to the need for medical supervision in the factory and workshop by practitioners having the necessary knowledge of the home conditions of the workers and the maladies attributable to industrial life in its widest sense.

A LECTURE ON SEX AND VENEREAL DISEASE HYGIENE*

EDWARD B. VEDDER, M.D.

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[At our request, Colonel Vedder has prepared the following article as a type lecture to be delivered to intelligent, adult employees on the subject of sex and venereal disease hygiene. — *Ed.*]

The Purpose of Sex

THE birth of young, whether animal or human, is such a common occurrence that we seldom realize that the production of a new individual is the most wonderful phenomenon in our experience. For it is an act of creation, and it is in the exercise of creative faculties that man most resembles God.

The question naturally arises, why is the union of male and female so essential? We know that bacteria and a few of the lowest animals reproduce asexually by simply dividing. But here there is no individuality; one bacterium is as like another as two bird-shot. On the other hand, among the higher animals that perpetuate themselves through sexual reproduction, every individual is different. There are roughly two billions of human individuals on this earth, no two of whom are precisely alike either physically or mentally; and it is this fact that makes life together and the progress of the race possible. It would be a most peculiar world if every man insisted on being a doctor. But as we are all different, one man chooses to be a doctor, another a lawyer, another a machinist, and so the world's work is done. Moreover, all special talent or ability is due to the happy blending of mental qualities as the result of some particularly fortunate mating. Thanks to the process of sexual reproduction, we shall never be without leaders in thought and action who point out the way to better things. This is what sex accomplishes for the race, and it is accordingly a matter to be treated seriously.

The Mechanism of Sex

You should be interested in the mechanism by which these results are accomplished. Every individual develops from a single cell which is formed from the union of a spermatozoön or male sexual cell and an ovum or egg, the female sexual cell. The spermatozoa are developed in the testicles or sex glands of the male, and the ova in the ovaries or sex glands of the female. Figures 1 and 2 will show you the structure of the male and female genital organs.

Active sexual life in this climate begins usually at the age of 14 or 15, and is called puberty. In the male this is indicated by a change in voice and the growth of hair on the face and other parts of the body. In the female there are corresponding changes, including the development of the breasts, but sexual maturity in the female is marked much more sharply by the appearance of the menstrual flow from the uterus. Menstruation is probably a process which prepares the uterus for the reception of a fertilized ovum. At any rate, at about the time that menstruation occurs each month, an ovum or egg is discharged from the ovary and finds its way to the uterus through the Fallopian tubes.

Nothing further happens unless this ovum is fertilized, but following sexual intercourse, spermatozoa are deposited in the vagina. These cells are actively motile and pass rapidly into the uterus and up the Fallopian tubes where they meet the ovum. A single spermatozoön enters the ovum, and the ovum so fertilized passes into the uterus where it lodges in the mucous membrane and undergoes the development that ends in the birth of a new individual.

When we examine the process of fertilization more closely, we find an actual physical basis for the transmission of hereditary qualities. As stated before, both the ovum and spermatozoön are single cells. All cells consist essentially of a membrane containing a substance called protoplasm of which all animal tissues are built, in the midst of which is a kernel or nucleus. This nucleus is sharply defined from the protoplasm of the cell, and contains a network composed of a substance that has been

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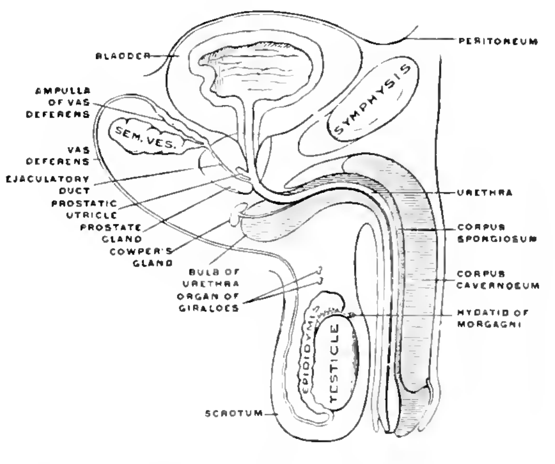

Fig. 1. — Diagrammatic representation of the male reproductive organs. (*From Gray's Anatomy.*)

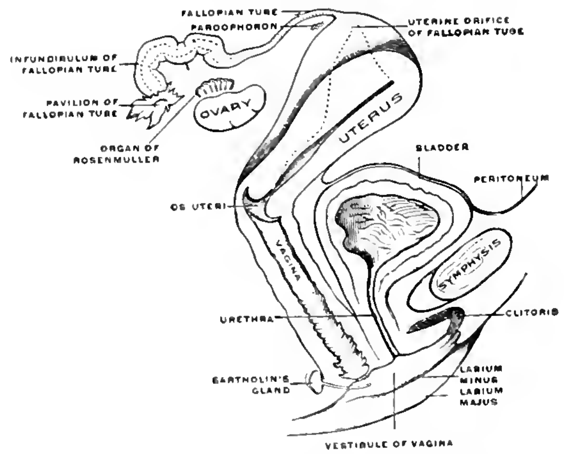

Fig. 2. — Diagrammatic representation of the female reproductive organs. (*From Gray's Anatomy.*)

called chromatin because it stains deeply with certain dyes. This nuclear chromatin is the regulator of all the vital activities of the cell, and in the sexual cells in addition contains and transmits the hereditary qualities.

Structure of the Sexual Cells. The spermatozoön consists of three parts, the head, midpiece and tail. The tail, by an active lashing movement enables the spermatozoön to progress through the mucus lining the uterus and Fallopian tubes. The head is the nucleus and contains the essential chromatin. The ovum is simply a spherical cell with a centrally placed nucleus.

Fertilization. — As soon as one of these actively moving spermatozoa comes in contact with the egg, the head or nucleus penetrates the egg, the tail being left outside. (Fig. 3a.) The egg becomes thereby changed in some manner so that no other spermatozoön can gain entrance to it. After the head or nucleus of the spermatozoön has penetrated the egg, it approaches the nucleus of the egg (Fig. 3b and c), fuses with it, and so the chromatin from the male cell fuses with the chromatin from the female cell. The egg so fertilized now divides and forms two cells; but the chromatin arranges itself in such a way that each of these cells has received half its chromatin from the male spermatozoön, and the other half from the female egg. (See Fig. 3d and e.) And this process continues in every subsequent cell division, so that in the adult body every one of the billions of cells of which it is composed contains equal parts of chromatin derived from the father and from the mother. As this chromatin governs all the activities of the cells, it is clear that every new individual is a composite of qualities received from his father and from his mother.

But since both our fathers and our mothers are a result of the same process, and all their cells, including their sexual cells, contained equal parts of chromatin derived from our grandfathers and grandmothers, it is evident that our parents must have handed down to us some of the chromatin-bearing part of the hereditary qualities of our grandparents. Furthermore, this same process extends back to our more remote ancestors, so that each one of us is really a mixture of various ancestral traits. Sometimes as a result of this process we have inherited a good quality from one of our ancestors, and perhaps a bad quality from another.

From this you can see why it is a good thing to have a long line of good ancestors, and why many people are proud of their ancestors. For it is clear that the higher the proportion of good ancestors, the greater is the probability that good qualities will be inherited. And as there is no possible limit to the combinations that can be made of this ancestral stuff or chromatin in the sex cells, we see how the purpose of sex is accomplished in the production of a great variety of individuals since no two children even of the same parents can be exactly alike. The great number of possible combinations also explains why we occasionally have good individuals from a bad ancestry and worthless individuals of good ancestry.

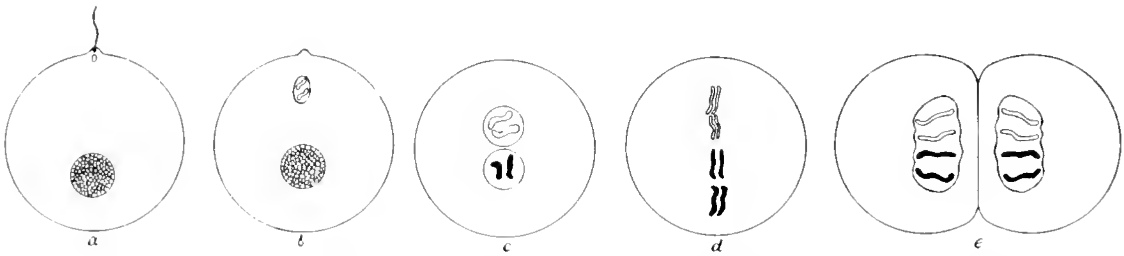

FIG. 3. — Diagrammatic representation of fertilization and the following segmentation of the ovum. Chromatin from the male element in light color; chromatin from the ovum heavily shaded.
(a) Head of spermatozoön entering egg.
(b) Male nucleus approaches female nucleus.
(c) and (d) Male and female chromatin becomes rearranged before cell division to insure equal distribution.
(e) Process of cell division showing that each cell receives equal parts of chromatin from the spermatozoön and the ovum.

VENEREAL DISEASE

Having briefly described the purpose and results of sexual reproduction, we now wish to discuss the diseases that ordinarily are transmitted during sexual intercourse with an infected person. There are three such diseases, namely, syphilis, gonorrhea, and chancroid. These diseases have usually been grouped under the title of "venereal diseases," although both syphilis and gonorrhea may be and frequently are transmitted in other ways.

Source of Infection. — All infectious diseases are caused by the growth in the body of minute parasitic organisms that for convenience may be called germs. These germs, for the most part, only grow and thrive when they gain access to people, and it is only in passing from one individual to another that some of them, for example the typhoid bacillus, may be found in water or food. Practically none of them live in the air. Therefore infected people and not things are the main source of infection. This is particularly true of the germs that cause syphilis and gonorrhea for they cannot develop anywhere except in people and die soon after leaving the body. Syphilis, gonorrhea and chancroid are contagious diseases; that is, the germs that cause them can only be acquired by intimate bodily contact with a person who is infected, or with bodily secretions that have recently left the infected body. To be infective such secretions must be very recent and still moist, for the germs of both syphilis and gonorrhea die as soon as the secretions that contain them become dried. These diseases are, therefore, as a rule only acquired by close bodily contact with an infected person.

Of all people, prostitutes are most liable to become infected with syphilis and gonorrhea, for it is evident that a woman who receives all who apply is certain to become infected sooner or later, and generally sooner. Careful medical examination of such women has shown that practically all are infected, and that the infection is acquired very soon after the women have adopted this life, and that they then continue to serve as sources of infection for several years. Prostitutes are, therefore, the main source of infection for men, and these infected men frequently infect their wives and children. The greater majority of those who suffer from a venereal disease today either received it from a prostitute or from someone who received it from a prostitute. Before we can eliminate syphilis and gonorrhea, or even reduce their incidence very materially, it will be necessary to suppress prostitution which is the main source of infection. It is, therefore, of some interest to determine the cause and origin of prostitution.

The Cause and Origin of Prostitution. — We arrive at sexual maturity at 14 or 15 years of age, whereas the mind is yet immature; and it will be from five to ten years later before years of discretion will be attained, economic independence can be achieved, and marriage will be possible.

Nature has implanted in the male a strong sexual appetite. Nature cares little for the individual but everything for the perpetuation of the race, and this strong instinct is undoubtedly necessary to carry out this purpose. The young man possesses this sexual appetite for all the years intervening between sexual maturity or puberty and the time when marriage becomes possible; and these are the very years when his judgment is poor and his character undeveloped. Very many young men at this time and older men who remain un-

married gratify their sexual instinct by a certain amount of promiscuous intercourse. The demand for this gratification has produced the prostitute or the woman who sells herself for the purpose. There are undoubtedly other contributory causes to account for prostitution. A large percentage of prostitutes are feebleminded or without moral sense. But it is clear that if the demand were not made, the supply would not be furnished. History indicates that prostitution is due to a deep-seated defect of human character and not to any fortuitous circumstances, for prostitution has been constantly present in all nations from the earliest civilization of which we have any record. It has been called "the oldest profession."

We do not know how syphilis and gonorrhea originated any more than we know when typhoid fever and smallpox first appeared in the human race. Like prostitution, syphilis and gonorrhea probably antedate written history. But we know that they are produced today by promiscuous intercourse, and we can guess that they were originally caused in the same way. It will now be well to give you a brief description of these three diseases.

Syphilis

Syphilis is caused by an organism belonging to the spirochetes called the Treponema pallidum. It is a very fine, corkscrew-shaped organism which is actively motile and is able to penetrate many tissues of the body. However, it does not often penetrate the unbroken skin, but usually gains access to the body through small abrasions of the mucous membranes. These infective organisms are present in all the lesions of syphilis, but particularly in the early ones, the chancre and the mucous patch.

Methods of Infection.—Syphilis may be acquired or congenital. In a majority of the acquired cases the infection is received through sexual intercourse with a person having the disease; but syphilis is often due to an accidental infection. Thus, a person who kisses a syphilitic or uses a drinking glass immediately after him may be infected. Persons having syphilis often have little sores in their mouths, called mucous patches, of which they may be unaware because they are painless. But they are extremely infectious, being full of spirochetes, and the saliva of such syphilitics is also infectious. In order to avoid such accidental infection it is a good rule to confine kissing to immediate members of the family, and not to put anything in the mouth that could have been used similarly by another person.

In congenital syphilis the child is born with the disease which has been received from an infected mother. Such children frequently die within a few weeks, and if they do survive are generally sickly. In very rare cases, the infection so received may remain latent for a number of years and manifest itself later in life.

Course of the Disease.—The first sign of acquired syphilis is usually a sore, the chancre, which appears on the spot where the infection was received. Thus it generally appears on the genitals, but in accidental infections it frequently appears on the lips, the fingers, and other parts of the body. This sore is not painful, but it is often very hard, does not heal readily, and commonly remains several weeks. It is a good principle to consult a physician about any sore on any part of the body that refuses to heal.

The typical hard chancre is usually recognized by an experienced physician, but unfortunately the primary sore may be so small and atypical as to pass unnoticed, or it may be confused with the sore produced by chancroidal infection. Therefore, when a sore of any kind appears on the genitals a physician should be consulted. There are two methods by which the doctor may determine whether the sore is a chancre, the initial lesion of syphilis:

1. The organisms that produce syphilis may be recognized under the microscope. The physician should, therefore, make repeated microscopic examinations of the serum expressed from the sore to determine whether these organisms are present. It is essential to the success of this examination that *the sore should be absolutely untreated*, for any local treatment usually causes the temporary disappearance of the organisms of syphilis.

2. The blood of the patient should be tested repeatedly by the so-called Wassermann reaction for at least three months from the time the sore appeared. It would take too long to explain this blood test, for it is quite complicated, but it is usually positive in cases of syphilis. Generally speaking, the microscopic examination is

more apt to be positive when the sore first appears and the blood test is more apt to be positive after the sore has lasted a long time; but both of these methods should be used in all cases.

If both of these methods have been conscientiously applied and are both negative, and the sore does not look or act like a chancre, the condition is probably not syphilis.

It is most important that the diagnosis should be made as soon as possible after the appearance of the sore because the earlier treatment is commenced in a case of syphilis, the better is the chance of securing a permanent cure. However, treatment should not be commenced until the diagnosis of syphilis is positively made, because this confuses the diagnosis and the patient will never know whether or not he has syphilis, and will be unwilling to take the treatment that would be necessary to secure a cure should the disease be syphilis.

After the sore has lasted for a time, the length of which varies in different patients, the organisms of syphilis gain entrance to the blood stream and the disease soon becomes general. The first constitutional symptoms are usually noticed within three months after the appearance of the chancre, and this is the beginning of the so-called secondary stage of the disease. At this time there may be some fever; but the commonest symptom is a reddish skin eruption which appears either as spots or raised papules all over the body. On those parts of the body covered with mucous membrane, such as the mouth or genitalia, small, painless grey sores appear, called mucous patches. These are the sores to which reference was made above, and these mucous patches and the primary sore or chancre are the most infectious lesions of syphilis. In addition to containing large numbers of the infective organisms, they are especially dangerous because the person who has them may not know that they are there, or even if he has noticed them, may not yet have found out that he is suffering from syphilis. Equally a prostitute may be in this very infectious stage for some time before she becomes aware of her condition, or may continue her traffic in spite of it.

At about this time, most patients receive some treatment, but usually an amount insufficient to produce a cure. The disease clears up and the patient is apparently well. But some months or years later the disease recurs in the so-called tertiary stage, and often the character of the disease has changed. The skin eruptions now have a tendency to form ulcers, and ugly sores that heal with difficulty may appear on any part of the body. Even the bones may be seriously affected; thus, the bridge of the nose is frequently destroyed, causing a repulsive deformity. The nervous system is also frequently involved, and the diseases known as locomotor ataxia and general paralysis of the insane are really cases of syphilis of the spinal cord and the brain. No part of the body is immune, and although syphilis may appear a very trifling matter when it begins, it is always serious. Unless it is treated most energetically by a competent physician, it usually means many years of suffering and invalidism, frequently disguised under some other name, and an early death between 40 and 50, at a time that ought to be the prime of life.

Gonorrhea

This is one of the commonest of infectious diseases. It is often thought a trifling matter, but as a cause of ill health and permanent disability it is little inferior to syphilis. The disease is caused by a biscuit-shaped micrococcus, called the gonococcus, which occurs in pairs, and in adults is always the result of impure sexual intercourse.

Course of the Disease. — The disease first appears as a purulent discharge from the urethra which in untreated cases may last for weeks or even months. In some cases the inflammation remains limited to the urethra but the tendency is for it to spread along all the genito-urinary passages. Thus, in the male, it often extends to the prostate gland, to the seminal vesicles and to the bladder. Quite frequently the inflammation extends to the tubules leading from the testicle to the seminal vesicles. These tubules are located back of the testicle, and the inflammation produces a painful swelling known as epididymitis. This condition often causes sterility in the male because the tubules become obstructed and spermatozoa can no longer pass through them. When the inflammation in the urethra finally heals, the damage is repaired by scar tissue which has a tendency to contract. In later years

these contracted scars are apt to cause an obstruction to the passage of urine, called a stricture. A large part of the urinary troubles of men are due to the results of old gonococcus infections.

In the female, the infection also spreads to contiguous parts, eventually reaching the Fallopian tubes. The chronic inflammation so produced often results in sealing up the orifices of these tubes and pus then collects in them. Such pus tubes often necessitate an abdominal operation for their removal. If the inflammation affects both sides, it may cause sterility in the female because ova can no longer pass through the constricted tubes.

In addition to this direct spread of the inflammation along the mucous surfaces, the gonococcus may gain entrance to the blood and so set up inflammation in widely separated organs. Thus it often causes an inflammation of the joints, called gonorrheal rheumatism, and this results in temporary or permanent disability. One form of heart disease is due to the same infection.

If the hands become soiled and the organism transferred to the eyes, it causes a very severe form of ophthalmia which frequently results in blindness. This eye infection may occasionally be acquired by using towels previously used by an infected person. Similarly, babies are infected during their passage through an infected genital tract. It has been claimed that about one-fifth of all blind people owe their misfortune to gonorrheal eye disease acquired at birth. Fortunately, we have found that this infection may be prevented by washing the new-born baby's eyes with a few drops of a silver nitrate solution. Most doctors now do this as a routine, and many infants' eyes have been saved by this procedure.

Chancroid

This infection is caused by a bacillus which is almost invariably acquired as the result of impure sexual intercourse. The growth of this bacillus produces sores on the mucous membranes where it was deposited. These sores may spread locally and cause much trouble, but the organism does not invade the blood, and therefore this disease is relatively unimportant as compared with syphilis and gonorrhea. However, it often does spread to the lymphatic glands in the groin causing them to swell and suppurate, when they are called buboes. This complication causes considerable disability and necessitates surgical treatment to remove the suppurating glands.

One of the worst features about a chancroidal infection is the fact that it is often very difficult to distinguish this sore from the chancre, which is the primary lesion of syphilis. To make this diagnosis early, or in time to afford a good chance for a permanent cure should the disease be syphilis, requires microscopic examinations and blood tests, as previously mentioned when describing the syphilitic chancre.

This very brief description of the venereal diseases has been given not only that you may know just what kind of diseases we are talking about, but also to enable you to realize that these infections are always of serious import. It is a common saying that a man who treats himself has a fool for a doctor. The use of patent medicines for these diseases is an absurdity which is already prohibited by law in some states. Should you ever suffer from any of these infections, be sure to obtain the best medical advice and treatment that you can secure. Thorough treatment will not only control the disease, but is the most effective means at our disposal for limiting the spread of such diseases. Even if you do not care anything about yourself, you do not want to pass on the infection to your friends, your wife or your children through neglect to take the proper treatment. And beware of the advertising quack. In the end you will lose time and money and health with him.

Prevalence of Venereal Disease

There are no perfectly satisfactory statistics regarding the prevalence of syphilis and gonorrhea. Great authorities like Fournier have estimated the prevalence of syphilis in large cities at from 10 to 15 per cent., but such estimates are very unsatisfactory because the prevalence of syphil's depends upon age, sex, marital condition and social status. It would take too long to give here even a summary of the mass of statistics that has been accumulated, and it will be sufficient for our purpose to say that from 50 to 100 per cent. of prostitutes have been shown to be infected with syphilis; that among the patients in various hospitals, from 10 to 30 per cent. have been

found to suffer from syphilis; that in all probability about 20 per cent. of the young men of the class that enlist in the army have been infected; while among unmarried women of good habits, the disease is quite rare. Among married women a fair percentage have been infected by their husbands. Probably 2 or 3 per cent. of children have been infected congenitally. Among negroes there are at least twice as many cases as among the white race.

With regard to gonorrhea, European authorities have estimated that 80 per cent. of all men have or have had gonorrhea. Morrow and other authorities in the United States believe that from 50 to 60 per cent. of all men have had gonorrhea. Among women, practically all prostitutes are infected and have chronic gonorrhea. And while gonorrhea is practically nonexistent among unmarried women of good habits, it is unfortunately no rarity among respectable married women who are infected by their husbands. And in asylums, homes and hospitals for little girls, when one case of the disease is introduced, it spreads like wildfire by indirect contact with sponges, thermometers and other objects, including the hands of the nurses, without any suspicion of sexual contact. Fortunately among adults this method of spread practically does not exist or everyone would suffer.

Colonel P. M. Ashburn, M.C. has just completed an investigation of the draft statistics, and has found that Class A men of white race and military age resident in the United States in the year 1918 showed at the time of their examination for service a venereal infection rate of approximately 3 per cent., while the negro infection rate shown in the same way was 20.85 per cent. These figures are the most comprehensive that have ver been gathered and in my opinion indicate with great exactness the percentage of active infections among men of the population of military age.

Whatever criticisms may be leveled at the statistics that have been gathered, it is sufficiently apparent that both syphilis and gonorrhea are very common infections; that gonorrhea is probably at least four times as common as syphilis; that together they produce more suffering, disability and death than tuberculosis or any other one disease; and that, heretofore, they have entirely evaded sanitary control.

Prevention

And now the question arises, how can we prevent these diseases? For you, individually, the answer is absurdly simple — namely, abstain from all sexual intercourse until you are married and then be faithful to your wife; and take those simple precautions about kissing, and the use of common drinking cups, towels, and other objects that have already been mentioned.

However, experience and the wide prevalence of venereal diseases have proven that chastity among men before marriage is the exception and not the rule. A questionnaire was sent to the soldiers in France, and from the replies it was learned that only about one-third had abstained from sexual intercourse while in France. You must not suppose that this was a bad record for the soldiers in France. As a matter of fact, it represents unusual self-denial, for there is excellent reason for believing that this was an improvement on the usual sexual habits of the same men at home.

We do not in the least approve of this state of affairs, but it would be foolish to close our eyes to it. Until men have learned to refrain, it is most desirable that infection should be prevented after exposure has taken place. There is a method of treatment that will prevent infection with a high degree of probability if it is used at once after exposure, and this method has been used in the army with good results. It consists of scrupulous cleanliness, the injection of a soluble silver salt to prevent gonorrhea, and an inunction of 33 per cent. calomel ointment to prevent syphilis. This is not the time or place to describe this method further, but if you have been misguided it will probably pay you to apply to some physician for this treatment.

Organized attempts by the community to reduce the prevalence of syphilis and gonorrhea are all aimed to secure one result, the elimination of the sources of infection. This problem may be approached from two angles:

1. The elimination of prostitution.
2. The treatment of all those infected.

The Elimination of Prostitution. This is especially desirable because it can hardly be questioned that prostitutes constitute the endemic center and main source of infection. It will be a long time before prostitution can be eliminated, if ever it can

be. But experience during the war has shown that it can be suppressed and reduced to a minimum by any community that desires to do so. But little good is accomplished by passing ordinances and spasmodic efforts in this direction; a constantly maintained effort to suppress the evil is required to diminish the traffic and the resultant infections. Such an effort requires the intelligent and willing coöperation of all citizens.

Treatment. — Effective treatment of all those infected would eliminate all sources of infection. Even those who could not be cured would be rendered incapable of transmitting infection. But the number of those infected is so large and effective treatment has been so expensive that the majority of those infected do not receive treatment early enough or in sufficient amount. To meet this situation most hospitals, many cities, and the United States Public Health Service have established clinics where advice and treatment can be secured by those unable to pay a private physician. Ordinarily, better advice and treatment may be secured at these clinics than can be given by the average physician who is not a specialist in these diseases.

Education. — But before the community can make much progress either in suppressing prostitution or in securing treatment for those infected, the education of the people is necessary. This is a democracy and any action of permanent value must be taken by the people themselves and not merely by some temporary official. All should know the nature and prevalence of syphilis and gonorrhea, their cost, the ways by which infection is acquired and the methods of prevention. They will then insist on the suppression of prostitution, and those infected will voluntarily try to secure treatment. Moreover, education should develop character so that the average man would restrain instead of indulging his appetites.

What argument can we use to induce men to restrain their sexual appetites? No manly man wishes to ruin an innocent girl, and an innocent girl is the only one who cannot transmit disease. Any woman who shares her favors is sure to become infected. Men are not afraid of infection for themselves. The late war has shown that heroism is not unusual; bravery is the rule and cowardice a rare exception. Fear of any kind is unmanly, cowardly, and if a man is not afraid of a bullet or of sudden death, why should he fear a disease that at most can but kill him and that after all is quite amenable to treatment? To base our appeals on a personal fear of infection is totally to misunderstand men.

But most men wish to be square. They demand a square deal for themselves and wish to treat others similarly. Most men expect to marry some day. It needs no lengthy argument to convince any man that it is not giving a girl a square deal to infect her with a disabling disease, and when a man has once suffered from syphilis or gonorrhea it is most difficult to say how long the infection will persist. Syphilitics have infected their wives after the disease has lasted ten years and more, and gonorrheal infections may also persist for several years. When either disease has been acquired within the year, the innocent wife is almost always infected. If the mother is infected with syphilis, she almost invariably infects her children. Commonly, she first suffers abortions; then she probably has a still-born child; and finally children that live, but usually with the marks of the disease. We have already said enough of the disabling effects of both diseases. Surely any man who considers this danger to wife and children will admit that the double standard of morality is indefensible.

A man can control his appetites perfectly well if he makes up his mind to do so. When a man does not, it is usually because he is not convinced of the desirability. Many a man has been a hard drinker until some episode forced him to realize that he was besotted, and he has then stopped drinking at once. The sexual appetite can be controlled when the necessity for such control is realized.

Fathers and mothers should investigate the health and sexual habits of the young men who wish to marry their daughters at least as carefully as they investigate their financial status. The time is coming when this will be done, and when any young man who cannot face the family doctor will be *persona non grata*.

In conclusion, it should be said that it would be utterly impossible to cover this entire subject in one lecture. But it is to be hoped that the main points have been touched without wearying you.

TWENTY YEARS' EXPERIENCE OF THE NOTIFICATION OF INDUSTRIAL DISEASES*

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IN factory legislation in Great Britain from about 1850 to 1906, first safety — that is, accident prevention by guarding of machinery — and subsequently, from about 1870 onwards, industrial disease prevention became more and more prominent. Public feeling was stirred by the seriousness of lead poisoning with cases of sequelae of blindness and paralysis in white lead and pottery manufacture, and by the suffering from "phossy jaw" in the manufacture of lucifer matches. Notable features of the factory legislation between 1878 and 1895 were the provisions made to control dangerous trades by means of special rules and to obtain early knowledge of certain occupational diseases — such as poisoning by lead, phosphorus, arsenic and mercury, and anthrax — by placing the obligation to notify them on medical practitioners and occupiers. Finally, under the Workmen's Compensation Act, 1906, twenty-five occupational diseases were scheduled to which the act, with differences depending on the essential distinction between accident and disease, applies. Some one with medical knowledge was required who would be able to follow up the cases reported and suggest remedial measures, and to this I owe my appointment. I would like to emphasize this point — the absolute necessity that such work should be done by a medical man and not by a layman, or, at any rate, that the final decision in any investigation made by a lay inspector should rest with a medical inspector.

The Factory and Workshop Act of 1895 required that every medical practitioner attending on or called in to visit a patient whom he believed to be suffering from poisoning by lead, phosphorus or arsenic or from anthrax, contracted in a factory or workshop, should notify it to the chief inspector of factories at the Home Office, and a similar duty was imposed upon the occupier to report every case to the district inspector of factories and to the certifying surgeon. In 1901, poisoning by mercury was added to the list of reportable poisonings, and still more recently, in 1917, toxic jaundice from tetrachlorethane, T.N.T., or any other poisonous substance was also added. We shall deal briefly later with further possible extensions. Since 1898 practically all the reports, and they must have numbered some 25,000, have passed through my hands, and I want today to give you the results of that experience — results of great value, despite the fact that the knowledge gained concerning each industry in which the poisons are used has been, and is likely to continue to be, somewhat incomplete.

In form, there is close similarity between this section dealing with industrial poisonings and that in the Infectious Diseases (Notification) Act, requiring the medical practitioner and the householder to notify the medical officer of health of every case of scarlet fever, diphtheria, etc. It is common knowledge that as regards the householder this enactment has been allowed to become a dead letter (although it still remains on the statute) because he is thereby credited with medical knowledge which cannot be expected of him. The case of the occupier of a factory is, perhaps, not quite on all fours with that of the householder because employing persons, as an occupier does, for his own profit on work in which poisonous substances are used, his duty to take practicable precaution is apparent, and should injurious effects show themselves in one of the workers his share in the responsibility for this must, within reason, be brought home to him. In a case of chronic lead poisoning or in a case of external anthrax, the occupier can have no difficulty in complying with the requirement of the act, but it is obvious that of the two, the medical practitioner's notification is the more important.

Notification of industrial disease is a more difficult matter than is notification of infectious disease, and if care is not taken the usefulness of the requirement may be greatly impaired. The objects in view are to obtain knowledge of prevalence, with a view to treatment and prevention — in

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other words, to obtain a clue to conditions over which the inspector or the state can exercise control. One difficulty of the practitioner in notifying industrial disease is that, with the exception of anthrax, the poisonings he is expected to notify do not present the same unmistakable signs that acute infectious diseases like smallpox or scarlet fever do. The number of cases which on investigation have to be marked as "wrong diagnosis"—fully 7 per cent.—are sufficient indication of the difficulty in complying with the notification section of the act. No absolute definition of what constitutes poisoning by lead, phosphorus, arsenic or mercury is possible, and each practitioner in reporting what he believes, must form his own standard in the same way as he forms his standard of what constitutes ptomaine poisoning or fish poisoning. The point is that, owing to the slow onset of these insidious industrial maladies, the patient passes through a stage of absorption which does not amount to poisoning and yet in which the stigmata of the particular compound are apparent. Take, for example, the blue line of the gums from lead absorption, the tremor from mercury, and the cyanosis of the lips from T.N.T. The medical practitioner has, therefore, in the first place, to make a differential diagnosis between the symptoms in lead poisoning and those of the commonest everyday ailment—headache, anemia, rheumatism, abdominal pain—or in a case of arsenical rash from the rash of idiopathic eczema, and secondly, he has to say whether absorption is so advanced as to justify him in notifying it as poisoning. A man presenting himself for treatment for bronchitis, for instance, who is discovered to have a blue line, should not be reported as a case of lead poisoning unless there are definite symptoms attributable to it, the blue line being regarded merely as evidence of work in lead. Common sense, however, points to the desirability of fixing in some way the degree of severity of symptoms which should lead to notification, and there are probably few medical men who would deny that symptoms necessitating absence from work and appeal to a doctor constitute sufficient grounds for notification.

But the mere presence of symptoms requiring medical assistance is not quite enough to settle the question of notification. Take, for instance, T.N.T. poisoning. This disease is so protean that it will show itself first as dermatitis; secondly, as gastritis; thirdly, in effects produced on the blood (formation of methemoglobin, with consequent reduction of its oxygen-carrying power); fourthly, in the specific destruction of the liver cells characterized by jaundice, a grave condition; and fifthly, in the rare form of aplastic anemia characterized by destruction of the red marrow of the bones with resulting great diminution of the red and white blood cells. These various symptoms are by no means always distinct one from another. With exception of the first, they are all to be described as T.N.T. poisoning, and they may merge one into the other—cyanosis may be present with gastritis or toxic jaundice, jaundice may be present with aplastic anemia—they may be interchangeable or concomitant manifestations of the same poison. I have dealt with them separately in order to insist that, for the purpose of statutory notification, all the forms are not equally important, although obviously the management of a factory should be aware of all cases. But when statutory notification has to be made, the medical practitioner and the occupier require a definite symptom to guide them. Publication of statistics of notifications of T.N.T. poisoning would, in my opinion, be unreliable, as they would simply refer to the number of T.N.T. workers seeking medical treatment for any and every complaint. But figures published monthly of the incidence of toxic jaundice furnish a real indication of serious illness due to the compound, calling in each case for inquiry as to causation and observance of precautions in the particular process at which the affected person was employed. This was the procedure adopted in England during the war. It reduced expense to the state, relieved the medical practitioner and occupier of doubt as to when to notify, and saved endless worry and the waste of time which would have resulted had a wider requirement been imposed. The same remarks apply to dope poisoning, which has no medical entity to be made notifiable. To attempt to notify dope poisoning would simply mean that all persons engaged in doping, who were absent from work from no matter what cause, would be reported as cases of dope poisoning.

In any further extension of notification of industrial disease, therefore, I would urge the desirability of scheduling a clearly

defined symptom as the criterion for notification. For instance, in order to obtain knowledge of the serious cases resulting from contact with tar, pitch and paraffin, and to avoid the very large number of slight cases of rash, pimples and boils from which at one time or other nearly all suffer who come into contact with the substances named, I would specify as a criterion for notification "epitheliomatous ulceration of the skin." Similarly the term "chrome ulceration" would suffice to exclude notification of the very slight cases of irritation set up on contact with bichromates. Indeed, I think we should be very much in the same position as we are now with regard to our knowledge of lead poisoning if we had limited notification to cases of lead paralysis. For statutory notification I hold that good samples are sufficient to obtain all the knowledge necessary on which to take action.

What I have said mainly in regard to difficulties in the notification of lead poisoning holds in even greater force with regard to arsenic poisoning. Arsenic poisoning, as you know, occurs in two distinct ways: (1) from inhalation of, or contact with, the dust of arsenic, showing itself in eczematous ulceration of the skin, especially where the dust alights on folds of the skin, and (2) from inhalation of arseniuretted hydrogen gas, producing severe constitutional symptoms as a result of the destruction of the red blood cells, and subsequent jaundice. Now the term poisoning presupposes constitutional symptoms due to disturbance of the systemic circulation, and effect on remote organs. Can a mere local effect such as irritation of the skin be regarded as poisoning by arsenic? I leave you to determine this point for yourselves. My own private opinion is that local effects set up by arsenic on the skin are not notifiable, but cases which are notified I follow up as though they were. Also, the classical symptoms of mercury poisoning, when fulminate of mercury is in question, are hardly ever observed. What is seen is altogether unclassical, namely, the appearance of conjunctivitis and irritation of the skin, not unlike that produced by arsenic; and hoarseness, the result of inhalation of fulminate of mercury. Unless constitutional symptoms were present also, I, personally, would not regard these effects of mercury as notifiable.

The notification section of the act, you will observe, is limited to poisoning contracted in a factory or workshop. Thus, lead poisoning contracted from drinking water is not notifiable, nor, as a rule, is poisoning in house painters notifiable since they do not usually contract poisoning in factories. Fortunately, however, medical practitioners do not split hairs over this point in regard to house painters, because the number of notifications received in this way exceeds that in other lead industries. These cases yield the only statistical information we have, apart from copies of death certificates, of lead poisoning among house painters and plumbers. Similarly, arsenic poisoning contracted from beer is not notifiable.

In order to leave no stone unturned in obtaining information from all sources, we have, in addition to the knowledge we receive from notifications, an arrangement with the registrar general, whereby notices of all death certificates on which lead poisoning is entered as directly or indirectly the cause of death are received by the chief inspector of factories. All deaths of industrial origin are included in the return, and the details recorded in each annual report. There has been difficulty in making the requirement known to all medical practitioners, notwithstanding the fee of 2/6 attached to it. The reason, I think, is this: The medical man is constantly reminded of his duty to notify ordinary infectious disease because it is an incident of his daily occupation. On the other hand, the majority of medical practitioners do not see a case of notifiable industrial disease from one year's end to another, and when they do, it is an accident and not an incident of their profession, and consequently they forget to notify or, perhaps, the necessary form for doing so is not at hand.

Principal Results Obtained from Notification

Now what are the principal results obtained from notification? Take first the cases of lead poisoning as shown in Table 1. We will deal with the figures for the years 1900 through 1914. The war brought about such changes in industry that special explanation of the subsequent figures, from 1915 to 1918, is required. Between 1900 and 1914, however, the figures are strictly comparable. There is first of all a gratifying

TABLE 1. — NOTIFICATION OF POISONING BY LEAD, PHOSPHORUS, ARSENIC AND MERCURY, OF ANTHRAX AND OF TOXIC JAUNDICE

Disease and Industries	Reported Cases *										
	1918	1917	1916	1915	Average 1912–14	Average 1909–11	Average 1906–08	Average 1903–05	1902	1901	1900
Lead poisoning	144^{11}	317^{21}	348^{21}	381^{21}	522^{33}	576^{35}	619^{30}	601^{23}	629^{14}	863^{34}	$1,058^{38}$
1 Smelting of metals	15^{1}	46^{1}	39^{4}	47^{1}	39^{1}	49^{4}	45^{2}	31^{1}	28	54^{3}	34^{1}
2 Brass works	1	3^{1}	3	—	7	7	9	10^{1}	5	6^{1}	3
3 Sheet lead and lead piping	—	3	3	3	6	8^{1}	9	9	12	17	17^{1}
4 Plumbing and soldering	24^{2}	34	12	17^{2}	32^{3}	30^{1}	21^{2}	24^{2}	23^{1}	23	9
5 Printing	8^{1}	6^{3}	12	27^{3}	27^{1}	29^{2}	24^{2}	16^{2}	19	23^{1}	18^{2}
6 File cutting	2	4^{1}	8^{2}	2	13	12^{1}	11^{1}	19^{2}	27	46^{7}	40^{3}
7 Tinning	2	2	4	3	11	17	18	13	11	10	5
8 White lead	—	17	18^{1}	40	27^{1}	36^{2}	86^{3}	105^{1}	143^{1}	189^{7}	358^{6}
9 Red lead	2	13	15	8	5	11	8	9	13	14	19
10 China and earthenware	11^{1}	15^{7}	23^{7}	26^{4}	56^{10}	76^{7}	109^{8}	96^{3}	87^{4}	106^{5}	200^{8}
10a Litho-transfers	—	—	—	—	1	1	6	4	2	7	10
11 Glass cutting and polishing	1	—	1	—	2^{1}	3^{1}	4^{1}	2	8^{2}	11^{3}	7
12 Vitreous Enamelling	—	1	5	5^{1}	8	14	6	3	3^{1}	9	11
13 Electric accumulators	16	27^{1}	44^{1}	64	41	27^{1}	24	29	16	49^{1}	33
14 Paints and colors	3	10	22	12	21	26^{1}	32	43^{1}	46	56	56^{1}
15 Coachbuilding	12^{3}	21^{2}	33	39^{5}	71^{4}	90^{6}	75^{4}	60^{4}	63^{1}	65^{4}	70^{5}
16 Shipbuilding	9^{2}	19	25^{3}	18^{2}	32^{3}	28^{3}	21^{1}	35^{1}	15^{1}	28^{1}	32^{2}
17 Paint used in other industries	15	20^{1}	20	16^{2}	45^{2}	50^{1}	44^{2}	41^{2}	41^{1}	61	50^{5}
18 Other industries	23^{1}	76^{4}	61^{3}	54^{1}	77^{2}	62^{3}	67^{3}	54^{1}	61	89^{1}	86^{4}
Phosphorus poisoning	3	3	2	3	—	1	1	1^{1}	1^{2}	4	3
Arsenic poisoning	3^{1}	30^{5}	—	3	4	7	12^{1}	4	4	1	22^{3}
Mercurial poisoning	9	17	18	6	14	10	7	6	8	18	9
Toxic jaundice	34^{10}	190^{44}	206^{57}	—	—	—	—	—	—	—	—
Anthrax	72^{8}	93^{12}	105^{16}	50^{8}	57^{7}	57^{11}	57^{13}	52^{13}	38^{9}	39^{10}	37^{7}
Wool	53^{5}	57^{8}	79^{10}	27^{3}	33^{5}	30^{5}	22^{5}	22^{6}	12^{2}	6^{4}	9^{2}
Horsehair	4^{2}	3^{1}	6^{3}	2	6	7	12^{3}	9^{2}	10^{2}	9^{1}	12^{3}
Handling of hides and skins	14^{1}	29^{2}	18^{3}	18^{4}	14^{1}	17^{3}	15^{3}	16^{3}	11^{5}	20^{5}	9^{1}
Other industries	1	4^{1}	2	3^{1}	4	2^{1}	9^{3}	6^{3}	5	4	7^{1}

* The principal numbers relate to cases, the small figures to deaths. Fatal cases not reported in previous years are included as both cases and deaths.

diminution in the total number of cases; they have diminished almost exactly by one half, from 1058 to 522. Selecting particular industries, notice the reduction in the figures for white lead from 358 to 27; in the pottery industry, from 200 to 56; in the manufacture of paints and colors, from 56 to 21; in file cutting, from 40 to 13.

Now like an honest surgeon I wish to describe the failures as well as the successes. Moreover, from the failures perhaps most is to be learned. The figures for smelting, you will see, show rather an increase as do those for printing and electric accumulators, while for coachbuilding, for shipbuilding and for paint used in other industries they are almost stationary. Now why is there the contrast between these figures — those for the first mentioned industries showing such a remarkable drop, the others showing little or no improvement over a number of years ? The answer, in my opinion, is simple and of profound and fundamental importance. Essentially, the cause is that in the satisfactory cases locally applied exhaust ventilation to remove dust and fumes at the point of origin can be effectively applied, and in the others it cannot. On the practical side there is little more to be learned about lead poisoning, and you can accept the statement as axiomatic that all lead poisoning arises from inhalation of dust and fume. This removed or prevented, there will be no lead poisoning. You might demur to this statement in regard to coach and house painting, but in these industries it is the sand papering of painted surfaces which is responsible for most of the absorption. I do not wish to be misunderstood and when, in enunciating a principle, I speak thus dogmatically, I do not wish at all to underrate subsidiary causes for minimizing poisoning and so maintaining efficiency, such as cleanliness, and periodic medical examination to detect the earliest signs and thus to direct attention to unguarded points in the process from which dust or fume *must* be coming off if signs of lead absorption are present. Labor-saving devices, especially in the white lead industry, have helped materially, and in the china

and earthenware industry the most recent drop is due to successful research in using a lead glaze with as much lead content as before, but in a form insoluble in the gastric juice.

When you are up against figures which, over such a number of years, show little or no diminution in industries where white lead paint is used, there can clearly be only one remedy and that is the substitution of a zinc oxide paint or of some innocuous compound in place of white and red lead. In smelting of metals and in making electric accumulators the bulk of the poisoning is undoubtedly due to dust and fume but the application of exhaust is not impossible, and, with meticulous attention to detail in the application of the ventilation, the figures should be brought down as much as they have been in the case of white lead and pottery manufacture.

When you turn to the figures from anthrax, you will see that the cases of illness show a definite tendency to rise in all the industries except in the horsehair industry where they have definitely fallen. The figures for wool are notably increased. Now what is the meaning of this increase? To few subjects has more attention been given than to the prevention of anthrax in industry. Special rules and regulations have governed the wool industry for a quarter of a century, requiring, among many other things, downward exhaust ventilation in opening and sorting. This has obviously been of little or no avail. Why? Because effort has been directed to minimize the effect and not to get at and destroy the cause. That has hitherto been considered too difficult — the anthrax spores being among the most resistant of organisms. Saturated steam, effective certainly in destroying the spores, unfortunately destroys at the same time the material for manufacturing purposes. Still the situation could not be left as it was and during the war, I am glad to say, much has been done. Largely as a result of the work of Mr. G. E. Duckering, an inspector of factories and a skilled chemist, working in conjunction with the bacteriologist of the Anthrax Investigation Board at Bradford, a method capable of disinfecting the wool on a commercial scale and as a business proposition has been elaborated. Already this year a disinfecting station is being erected in Liverpool. I do not refer more to this subject as I am dealing with it in a later lecture.

In the horsehair industry the diminution of cases of illness is probably due to the fact that the disinfection of horsehair from China, Siberia and Russia has been prescribed in regulations since 1907.

Similarly, the diminution in cases of toxic jaundice has been due to the recognition of the cause as being absorption through the skin. When once this was recognized, meticulous attention to detail in cleanliness of the skin and cleanliness in the method of working reduced the poisoning.

The figures for phosphorus poisoning have fallen between 1900 and 1914 because of the act passed in 1908 prohibiting the use of white phosphorus in the manufacture of lucifer matches, and the figures for arsenic poisoning have fallen between 1900 and 1914 because there was a successful application of locally applied exhaust ventilation to remove the dust in the packing of emerald green. Nearly all the twenty-two cases in 1900 were cases of dermatitis and ulceration of the skin caused by that compound.

So far no impression has been made on the number of cases of mercurial poisoning. Metallic mercury, fortunately, is not very widely used in industry.

I said that I would speak of the figures for the years between 1915 and 1918 separately. The effect of the war can be read into them readily and they have interest, showing, as they do, how important branches of industry were directly or indirectly affected by the dislocation of work, an increase of cases occurring in one industry and a decrease in another. The calling up of men removed a class who might have been affected had they remained, and their place was taken by women in a number of industries. Lead usually takes several months or years to show its effects and there has been no considerable increase in the number of women reported as suffering from lead poisoning. This may be due to the fact that they have not worked long enough, but it may be equally true to say that the greater precautions now taken in the removal of lead dust by exhaust ventilation have made the processes in which the women are employed much safer than they used to be.

The figures for trades such as building, carriage and motor car construction, and porcelain enamelling show marked diminution, and especially is this the case with house painting. These trades practically

TABLE 2. — ANALYSIS OF REPORTED CASES OF LEAD POISONING SHOWING SEVERITY AND NUMBER OF ATTACK

Year	Severity of Attack										Number of Attack									
	Severe		Moderate		Slight		Not Stated		Total		1st		2d		3d or Chronic		Not Stated		Total	
	M.	F.	M.	F	M.	F	M	F	M.	F.	M.	F	M	F	M	F	M	F	M.	F.
Tot. 1900–09																				
Cases....	1,588	204	1,389	269	2,522	496	138	32	5,637	1,001	3,800	799	871	119	758	46	208	37	5,637	1,001
Per Cent...	28.2	20.4	24.7	26.9	44.7	49.5	2.4	3.2	100	100	67.4	79.8	15.5	11.9	13.4	4.6	3.7	3.7	100	100
Tot. 1910–14																				
Cases...	450	27	790	117	1,184	141	27	6	2,451	291	1,863	260	305	17	251	8	32	6	2,451	291
Per Cent	18.4	9.3	32.2	40.2	48.2	48.5	1.1	2.1	100	100	76.0	89.4	12.5	5.8	10.2	2.7	1.3	2.1	100	100

stopped during the war. Although not notifiable, the number of cases among house painters of which we obtained knowledge prior to 1915 was always higher than in any other industry. Thus, in 1913 there were 291 cases, with 37 deaths; and in 1912, 256 cases with 47 deaths. The figures fell in 1916 to 72 cases, with 20 deaths; in 1917, to 57 cases with 18 deaths; and in 1918, to 35 cases with 20 deaths. Other painting operations were not affected to the same extent. Indeed, the figures for "paints used in other industries" show little or no change. During the war there was less printing, owing to the shortage of paper. This is reflected in the figures from 1916 onwards.

From an early date in the war, lead was controlled by the Ministry of Munitions. On its use for government work, including smelting, conversion into shrapnel, the manufacture of electric accumulators, sheet lead and lead piping required for the manufacture of acids, etc., no limits were placed, but wherever private orders were in question the supply was restricted. The heavy pressure placed on firms where smelting of lead was carried on is shown in the figures. Of the total 147 cases, thirty-two were contracted in the extraction of spelter. The comparatively very high figures for plumbing and soldering were undoubtedly due to the great amount of lead burning required in erecting the acid chambers, vats, etc., in large munition factories. The conditions under which the men engaged had to carry on their work, exposed as they were to acid fumes and other defective conditions, were often trying. The manufacture of electric accumulators for submarines and other purposes connected with the war was carried on at very high pressure night and day, and accounts for the high figure reached in 1915.

Figures referring to white lead, red lead, and paints and colors, may be grouped together. The absence of a single reported case of poisoning from the manufacture of white lead in 1918 is remarkable, seeing that in 1899 there were 399 cases. The manufacture was rationed to about 50 per cent. of the pre-war output. The works were closed entirely in 1917 for six months but in 1918 activity in them was considerable when quantities were manufactured equal to about 60 per cent. of that in pre-war time. Red lead was in great demand and the figures in 1916 and 1917 show it. The amount of lead allowed in glazing pottery represented about 50 per cent. of that used in ordinary times. In considering the use of lead in the various industries

TABLE 3. — ANALYSIS OF REPORTED CASES OF LEAD POISONING SHOWING MAIN SYMPTOMS

Year	Main Symptoms													
	Gastric		Anemia		Headache		Paretic		Encephalopathy		Rheumatic		Other	
	M.	F	M.	F.	M.	F.	M.	F.	M.	F	M	F.	M	F.
Total 1900–09 Cases.......	4,512	779	1,473	325	539	255	1,190	153	200	62	568	107	176	16
Per Cent..................	80.0	77.8	26.1	32.5	9.6	25.5	21.1	15.3	3.5	6.2	10.3	10.7	3.1	1.6
Total 1910–14 Cases	1,853	225	825	112	303	81	333	15	53	10	293	28	186	12
Per Cent	75.7	77.3	33.7	38.5	12.4	27.8	13.6	5.2	2.6	3.4	12.0	9.6	7.6	4.1

it has to be borne in mind that not only were we producing material for our own country, but that France and the allied states also relied on us.

I thought it would be interesting to interpose these details as to the principal results, but I ought now to go back and explain precisely how they have been obtained.

The notification of the practitioner gives, as a rule, no indication of symptoms beyond his belief that the case is one of lead poisoning. Details of a case are obtained in an examination of the patient, a day or two later, by the certifying surgeon, and the knowledge that we have obtained in the course of years is based entirely on a close analysis of the reports of certifying surgeons made on a prescribed form. Only when the cases are carefully analyzed, distinguished according to their severity, to the length of time of exposure to the injurious action of lead, to the number of previous attacks, to the nature of the symptoms, and to the precise occupation is their value brought out.

In the year 1910 I analyzed nearly 7,000 certifying surgeons' reports on lead poisoning, and again in 1915 over 2,700 obtained in the five years, 1910–1914, noting carefully, first, increase or decrease in the recorded number of cases in each one of eighteen classes of lead industries; secondly, the severity of the attack; thirdly, the number of the attack (whether first, second or chronic); and fourthly, main symptoms. These analyses are shown in Tables 2 and 3. Very frequently a combination of symptoms — colic, anemia, and varying degree of paralysis — is stated, and when this is the case each one of them has been entered under the appropriate heading. The total number of symptoms, therefore, greatly exceeds the number of cases, but this does not affect the correctness of the estimate of each one as a proportion of the total number reported. The reports, it need hardly be said, do not give detailed information such as can be gained from hospital records. Especially is this the case with the symptoms of paralysis and encephalopathy.

The cases include all attacks reported in a year and not previously reported in the preceding twelve months. By adopting this course no name appears twice in the same year. Taking the figures as a whole, the most noticeable feature is the reduction in the number of severe cases in the later period. And the fall in the number of severe cases is accounted for by the noticeable diminution of paralysis of the forearm, and also happily, by diminution in the most serious form which lead poisoning can take — affection of the brain — spoken of as encephalopathy. Encephalopathy can only be due, in my opinion, to inhalation of large quantities of lead dust, and one case of encephalopathy should, to my mind, be the cause of a far more searching inquiry than ten cases of colic.

The figures I have given you sufficiently emphasize the value to be obtained from notification of clearly defined industrial diseases when sufficient time is given by a medical man to the elucidation of the subject.

BOOK REVIEWS

Industrial Nursing: A Handbook for Industrial and Pupil Nurses and for Employers of Labor. By Florence Swift Wright, Supervisor, Bureau of Child Hygiene, New Jersey State Department of Health, formerly Secretary of the Benefit Association of the Employees of John Wanamaker, New York; and formerly in charge of Industrial Nursing for both the Cheney Brothers' Silk Mills and the Clark Thread Company. Cloth. New York: The Macmillan Company, 1919.

At this time of great industrial unrest, it was important that someone should present the subject of industrial nursing, and it is most fortunate that it has come from a woman who speaks out of a long and varied experience and with an appreciation of standards and a vision of the future for the industrial nurse.

A brief historical sketch of the growth of industrial nursing is given, followed by a discussion of the qualities and training necessary to equip a nurse to meet the obligations and opportunities in industry. She should have "a liberal education before hospital training" and "a working knowledge of psychology and of civics, industrial, social and relief problems."

While holding a high standard of personal qualifications and professional training, Miss Wright makes clear the necessity for the nurse to remain plastic and ready to fulfill the developing variation of opportunities that industry holds for her. The fundamental principles on which the work should grow are stated. Special attention is given to the discussion of the relation of the nurse to the employer, the physician, fellow-workers and employees. Emphasis is laid on the great opportunity of the nurse as a teacher of American standards of living and hygiene. The first-aid room offers a favorable opportunity for much health teaching and for getting to know the employees. Many personal problems are by this channel brought to the nurse.

Many practical suggestions concerning the equipment and rearrangement of the first-aid room are given. Also the chapters on records and reports, the relation of the nurse and the employment office, and the lunch room are illustrated with forms and outlines that have been used with success.

Miss Wright presents the function of the industrial visiting nurse as a logical development of care of patients in the first-aid room. She discusses the relation of the industrial visiting nurse to the local organization where there is one, and also presents the very broad opportunity of the industrial nurse in the community that exists largely because of the industry. In such a town, the industrial nurse may develop a center from which visiting nursing service is extended into the homes. The nurse's home may become a community health center.

The chapters on the nurse's relation to the industrial physician and to the employment office and the chapters dealing with her more personal relations to the employees, both within the industry and in their own homes, bring out clearly the opportunity of the nurse in the great problem of human relations in industry.

Characteristic of the practical quality of the book is the appendix in which are found some important first-aid rules, a list of important sources of information on public health and social problems which are encountered by industrial nurses, and a classified bibliography. — *Ida M. Cannon.*

Human Vitality and Efficiency Under Prolonged Restricted Diet. By Francis G. Benedict, Walter R. Miles, Paul Roth, and H. Monmouth Smith. Pp. 701, with illustrations. Washington: The Carnegie Institution of Washington, 1919.

This is a voluminous report (701 pages) embodying the results of an investigation probably unequaled heretofore in scale and thoroughness. Many of the observations are of far more than academic interest. The work was undertaken in 1917 because of the enforced attention paid in wartime to restricted food supply, actual and prospective. How well such reduction of the ration could be borne by active adults was a matter of the utmost concern.

The subjects who volunteered for service in this trial were students at the International Young Men's Christian Association College, Springfield, Mass. Twenty-four were chosen; unavoidable substitutions brought the total to twenty-eight. Very considerable hardships were involved in carrying out the program and the investigators have paid a warm tribute to these young men for their fortitude and fidelity.

The procedure followed with Squad A (twelve subjects) may be indicated. It will not be necessary to speak in detail of the confirmatory management of Squad B. The first aim was to reduce the body weight of the subjects by approximately 10 per cent. Such a loss would result from fourteen days of complete fasting; it was actually secured by going on half-rations for six to eight weeks. The desired level being attained, the supply of food was made just sufficiently liberal to protect against further loss and the low figure was maintained for about two months. At the outset most of the men were slightly overweight by the accepted standards. All but four were decidedly underweight at the minimum. The allowances of food during the reduction period were valued at about 1500 Calories, rising to about 2000 Calories in the period of maintenance. Elaborate observations of metabolism, anthropometric data, physical and mental capacity were made throughout.

The outstanding fact is that a 10 per cent. reduction in weight was attended by a cut of about 40 per cent. in food consumption. This striking economy is referable to several conditions. First, the requirement for bare maintenance (basal metabolism) fell to an unexpected extent; that is, it became not only absolutely less but also much less when referred to kilogram of body weight or square meter of surface. Second, the "cost of digestion" was lowered in proportion to the intake of food. Third, muscular activity could be carried on at lower cost because of the reduced mass of tissue to be moved. Finally there

was, no doubt, a considerable curtailing of exercise, though this was not intended.

Without going into the details of the tests, it may be said that strength, endurance, and mental alertness did not suffer material impairment. Blood-pressure and heart-rate were considerably diminished. There was marked sensitiveness to cold. The chief drawbacks of the regimen were of a subjective character: galling hunger, depression of spirits, and a feeling of weakness which did not correctly indicate the actual resources. It may be noted that this indisposition to be active is a sound biological instinct as it favors the conservation of the limited stores of the organism. Men of less principle and resolution than these picked subjects might have been more seriously hampered in the performance of their daily work. Miles has called attention to a depression of sex-life among the members of the group which amounted almost to extinction.

These extended studies should serve to correct certain prevalent misconceptions. Chief of these is the belief that a man may greatly reduce his diet without changing his weight or his activities. Lusk has often protested against this notion. More confidently than ever, we can now say that the man who is over-weight is the man who overeats. One who is not above the standard weight cannot be charged with eating too much. The impressive demonstration is that a moderate sacrifice of weight can effect so large a saving. Under the stress of war, great populations have doubtless undergone this process. We recognize at once the possibility and the serious discomfort entailed.

On the theoretical side, the authors feel that the most interesting question raised is the cause of the lowered basal metabolism. The reduction referred to square meter of body surface per day was from about 1700 Calories to about 1400. It is suggested that this fall was consequent upon the large loss of nitrogen which was a feature of the experiments. This amounted, on the average, to 175 grams for each man. With the removal of so much protein or closely related material it is thought that a chemical stimulus previously acting to accelerate the general metabolism was withdrawn. In the present study the diet reduction affected all types of food in about the same proportion. A special investigation of rations low in fuel value but relatively high in protein is recognized as desirable. — *Percy G. Stiles.*

Hygiene and Public Health. By George M. Price, M.D. Second Edition, thoroughly revised. Cloth. Pp. 256 and index. Philadelphia: Lea & Febiger, 1919.

This is a handbook in which an attempt has been made to give in condensed form a complete survey of the various fields included in modern hygiene and public health. As the author states, in a subject so vast and embracing so many correlated branches and sciences, the work of epitomization is especially difficult; but the book gives a well-balanced presentation of most of the essentials. The treatment of the material in the chapter on industrial hygiene is especially admirable; and the inclusion in the chapter on the prevention of infectious diseases of the recent report of the American Public Health Association Committee on Standard Regulations for the Control of Communicable Diseases brings this subject up to date. It seems, however, that the subject of vital statistics, one of the very important branches of public health science, has been given altogether too brief mention in this volume.

The chapter headings are: Introduction, Housing Hygiene, School Hygiene, Industrial Hygiene, Public Water Supply, Food Supply, Milk Supply, Disposal of Waste Matter, Public Nuisances, Prevention of Infectious Diseases, Federal Hygiene. — *Barnett Cohen.*

Pathological Physiology of Internal Diseases. By Albion Walter Hewlett, M.D., B.S., Professor of Internal Medicine and Director of Clinical Laboratory, University of Michigan. Pp. 686 with index and illustrations. New York: D. Appleton and Company, 1919.

The grading of physical efficiency depends, in the end, upon capacity to appreciate altered structure and altered physiology. Hewlett's book gives one the functional basis of disease and bridges the gap between anatomy, physiology, and biochemistry and clinical medicine. The industrial physician who retains and applies the facts of scientific medicine to his work will find foundation for thought and advance in this text, which is certainly the best example of applied physiology at present obtainable. It is a matter for regret that a book published in 1919 dates, in terms of the material presented, from 1916, but the arrangement and treatment of the subject make one ready to forgive a situation which has unquestionably been forced by the conditions of the last few years. — *C. K. Drinker.*

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Syphilis: A Treatise on Etiology, Pathology, Diagnosis, Prognosis, Prophylaxis, and Treatment. By Henry H. Hazen, A.B., M.D., Professor of Dermatology and Syphilology, Medical Department of Georgetown University; Professor of Dermatology and Syphilology, Medical Department of Howard University; Member of American Dermatological Association and National Association for Control of Syphilis; Visiting Dermatologist and Syphilologist to Georgetown University Hospital, Freedmen's Hospital, Washington Asylum Hospital, and Woman's Evening Clinic; Author of *Diseases of the Skin*, *Cancer of the Skin*, etc. Cloth. Pp. 647 with illustrations, bibliography and index. St. Louis: C. V. Mosby Company, 1919.

The Practitioner's Manual on Venereal Diseases. With Modern Methods of Diagnosis and Treatment. By A. C. Magian, M.D., Ancien élève de l'Hôpital St. Louis, Paris; Hon. Surgeon Manchester French Hospital; Hon. Surgeon Wood Street Clinic for Genito-Urinary Diseases. Cloth. Pp. 215 with illustrations and index. St. Louis: C. V. Mosby Company, 1919.

Anaphylaxis and Anti-Anaphylaxis and Their Experimental Foundations. By Dr. A. Besredka, Professor at the Pasteur Institute. With a preface by Dr. E. Roux, Member of the Institute, Director of the Pasteur Institute. English Edition by S. Roodhouse Gloyne, M.D., D.P.H., Pathologist, City of London Hospital for Diseases of the Chest, Victoria Park. Cloth. Pp. 143 with index. St. Louis: C. V. Mosby Company, 1919.

SUBJECT INDEX TO VOLUME I

This is a subject index to all the reading matter in the JOURNAL OF INDUSTRIAL HYGIENE and one should, therefore, look for the subject word, with the following exception: "Book Notices" are indexed under this title on page 603. The name of the author follows the subject entry in brackets.

For author index see page 605.

BOOK NOTICES

AUTHOR INDEX TO VOLUME I

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

SUPPLEMENTARY TO

THE JOURNAL OF INDUSTRIAL HYGIENE

EDITORS

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ABSTRACT *of the* LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME I | MAY, 1919 | NUMBER 1

CONTENTS

LIST OF PERIODICALS

Each of the following periodicals will be examined systematically for material pertinent to the subject of industrial hygiene. In the main, abstracts of American periodicals will begin with the January, 1919, issues; abstracts of foreign periodicals will begin with the latest issues current in the United States in January, 1919. No periodicals are included in the list which are not at the present time being received regularly in the United States. A number of foreign periodicals will gradually be added to the list as their publication abroad is resumed and as they begin to reach the United States.

Articles of interest appearing in publications other than those on the following list will frequently be abstracted. In such cases the title of the publications in which the articles in question appear will be written out in full. Articles, especially technical papers, which can not be satisfactorily abstracted in brief space, will frequently be listed by title only. Papers which, in the opinion of the editors, have no merit will not be included in the abstracts.

TITLE OF PERIODICAL	ABBREVIATION
American Architect, The	Am. Arch.
American City, The	Am. City
American Economic Review, The	Am. Econ. Rev.
American Industries	Am. Industries
American Journal of Care for Cripples	Am. Jour. Care Cripples
American Journal of Insanity, The	Am. Jour. Insan.
American Journal of Nursing, The	Am. Jour. Nursing
American Journal of Ophthalmology	Am. Jour. Ophth.
American Journal of Physiology, The	Am. Jour. Physiol.
American Journal of Public Health	Am. Jour. Pub. Health
American Journal of Roentgenology, The	Am. Jour. Roentgenol.

Title of Periodical	Abbreviation
American Journal of Science, The	Am. Jour. Sc.
American Journal of Sociology, The	Am. Jour. Sociol.
American Journal of the Medical Sciences, The	Am. Jour. Med. Sc.
American Labor Legislation Review, The	Am. Labor Legis. Rev.
American Political Science Review, The	Am. Pol. Sc. Rev.
American Review of Tuberculosis, The	Am. Rev. Tuberc.
Annales de dermatologie et de syphiligraphie	Ann. de dermat. et de syph.
Annales d'hygiène publique et de médecine légale	Ann. d'hyg. pub.
Annales de l'Institut Pasteur	Ann. de l'Inst. Pasteur
Annales de médecine	Ann. de méd.
Annali d'igiene	Ann. d'ig.
Annali di medicina navale e coloniale	Ann. di med. nav. e col.
Annals of Otology, Rhinology and Laryngology	Ann. Otol., Rhinol. and Laryngol.
Annals of Surgery	Ann. Surg.
Annals of the American Academy of Political and Social Science	Ann. Am. Acad. Pol. Sc.
Architecture and Building	Arch. and Bldg.
Archiv für die gesamte Physiologie des Menschen und des Thiere (Pflüger's)	Arch. f. d. ges. Physiol.
Archiv für experimentelle Pathologie und Pharmakologie	Arch. f. exper. Path. u. Pharmakol.
Archiv für Hygiene	Arch. f. Hyg.
Archiv für Ophthalmologie	Arch. Ophth.
Archives de médecine et de pharmacie militaires	Arch. de méd. et de pharm. mil.
Archives de médecine expérimentale et d'anatomie pathologique	Arch. de méd. expér. et d'anat. path.
Archives d'Ophtalmologie	Arch. d'opht.
Archives des maladies du coeur, des vaisseaux et du sang	Arch. d. mal. du coeur
Archives of Internal Medicine, The	Arch. Int. Med.
Archives of Ophthalmology	Arch. Ophth.
Archives of Radiology and Electrotherapy	Arch. Radiol. and Elec.
Berliner klinische Wochenschrift	Berl. klin. Wchnschr.
Biochemische Zeitschrift	Biochem. Ztschr.
Boston Medical and Surgical Journal, The	Boston Med. and Surg. Jour.
Brain: A Journal of Neurology	Brain
British Journal of Dermatology and Syphilis, The	Brit. Jour. Dermat. and Syph.
British Journal of Nursing, The	Brit. Jour. Nursing.
British Journal of Ophthalmology	Brit. Jour. Ophth.
British Journal of Surgery, The	Brit. Jour. Surg.
British Medical Journal, The	Brit. Med. Jour.
Bulletin de l'Academie de médecine	Bull. de l'Acad. de méd.
Bulletin of the Johns Hopkins Hospital	Bull. Johns Hopkins Hosp.
Bulletin of the New York State Industrial Commission, The	Bull. N. Y. State Ind. Com.
Bullettino delle scienze mediche	Bull. d. sc. med.
Canadian Engineer, The	Canad. Engineer
Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten	Centralbl. f. Bakteriol.
Chemical Abstracts	Chem. Abstr.
Chemische Zentralblatt	Chem. Zentralbl.
Child Labor Bulletin, The	Child Labor Bull.
Chirurgia degli organi di movimento, La	Chir. d. org. di movimento
Correspondenz-Blatt für schweizer Aerzte	Cor-Bl. f. schweiz. Aerzte
Dermatologische Wochenschrift	Dermat. Wchnschr.
Dermatologische Zeitschrift	Dermat. Ztschr.
Deutsches Archiv. für klinische Medizin	Deutsch. Arch. f. klin. Med.
Deutsche medizinische Wochenschrift	Deutsch. med. Wchnschr.
Domestic Engineering	Dom. Engin.
Economic Geology	Econ. Geol.
Economic Journal, The	Econ. Jour.
Engineer, The	Engineer
Engineering	Engin.
Engineering News-Record	Engin. N.-Rec.
Factory	Factory
Fortschritte auf dem Gebiete der Röntgenstrahlen	Fortschr. a. d. Geb. d. Röntgenstrahlen
Great Britain Annual Report of the Chief Inspector of Factories and Workshops	Great Britain Ann. Rep. Chief Inspect. Factories and Workshops
Heart	Heart
Heating and Ventilating Magazine, The	Heat. and Ven.
Hygienische Rundschau	Hyg. Rundschau
Igiene moderna	Ig. mod
Index Medicus: Sections on Construction and Management of Hospitals; Hygiene of Habitations; Hygiene and Diseases of Occupations; Hygiene of Person; Toxicology; Poisonous and Asphyxiating Gases; Reconstruction, Re-education, Rehabilitation	

Title of Periodical	Abbreviation
Industrial Management	Ind. Management
Journal de physiologie et de pathologie générale	Jour. de physiol. et de path. gén.
Journal of Bacteriology	Jour. Bacteriol.
Journal of Biological Chemistry, The	Jour. Biol. Chem.
Journal of Cancer Research, The	Jour. Cancer Research
Journal of Cutaneous Diseases, Including Syphilis, The	Jour. Cutan. Dis.
Journal of Experimental Medicine, The	Jour. Exper. Med.
Journal of Hygiene, The	Jour. Hyg.
Journal of Industrial and Engineering Chemistry, The	Jour. Indust. and Engin. Chem.
Journal of Infectious Diseases, The	Jour. Infect. Dis.
Journal of Laboratory and Clinical Medicine, The	Jour. Lab. and Clin. Med.
Journal of Laryngology, Rhinology and Otology, The	Jour. Laryngol., Rhinol. and Otol.
Journal of Medical Research, The	Jour. Med. Research
Journal of Nervous and Mental Disease	Jour. Nerv. and Ment. Dis.
Journal of Orthopedic Surgery, The	Jour. Orthop. Surg.
Journal of Parasitology, The	Jour. Parasitol.
Journal of Pathology and Bacteriology, The	Jour. Path. and Bacteriol.
Journal of Pharmacology and Experimental Therapeutics, The	Jour. Pharmacol. and Exper. Therap.
Journal of Physiology, The	Jour. Physiol.
Journal of Political Economy, The	Jour. Pol. Econ.
Journal of Sociologic Medicine, The	Jour. Sociol. Med.
Journal of State Medicine, The	Jour. State Med.
Journal of Tropical Medicine and Hygiene, The	Jour. Trop. Med.
Journal of the American Chemical Society	Jour. Am. Chem. Soc.
Journal of the American Medical Association, The	Jour. Am. Med. Assn.
Journal of the American Waterworks Association	Jour. Am. Waterworks Assn.
Journal of the Boston Society of Civil Engineers	Jour. Boston Soc. Civ. Eng.
Journal of the Franklin Institute	Jour. Franklin Inst.
Journal of the Institute of Actuaries	Jour. Inst. Actuaries
Journal of the New England Waterworks Association	Jour. New Eng. Waterworks Assn.
Journal of the Roentgen Society, The	Jour. Roentg. Soc.
Journal of the Royal Army Medical Corps	Jour. Roy. Army Med. Corps
Journal of the Royal Naval Medical Service	Jour. Roy. Nav. Med. Serv.
Journal of the Royal Sanitary Institute	Jour. Roy. San. Inst.
Journal of the Society of Chemical Industry	Jour. Soc. Chem. Indust.
Kolloid-Zeitschrift	Kolloid-Ztschr.
Labour Gazette, The	Labour Gaz.
Lancet, The	Lancet
Machinery	Machinery
Mechanical Engineering	Mech. Engin.
Medical Officer, The	Med. Officer
Medical Record	Med. Rec.
Mémoires et compte rendu des travaux de la Société des ingénieurs civils de France	Mém. et comp. rend. d. trav. Soc. ingén. civ. de France
Mental Hygiene	Ment. Hyg.
Metal Worker, Plumber and Steam Fitter	Metal Worker, etc.
Military Surgeon, The	Mil. Surgeon
Mining Magazine, The	Mining Mag.
Mining and Scientific Press	Mining and Sc. Press
Modern Hospital, The	Mod. Hosp.
Monatsschrift für Psychiatrie und Neurologie	Monatsschr. f. Psychiat. u. Neurol.
Monographs of the Rockefeller Institute for Medical Research	Monogr. Rockefeller Inst. Med. Research
Münchener medizinische Wochenschrift	München. med. Wchnschr.
Municipal and County Engineering	Munic. Eng.
Municipal Engineers Journal, The	Munic. Eng. Jour.
Municipal Journal	Munic. Jour.
National Industrial Conference Board Publications	Nat. Ind. Conference Board Pub.
National Municipal Review	Nat. Munic. Rev.
Nederlandsch Tijdschrift voor Geneeskunde	Nederl. Tijdschr. v. Geneesk.
New York City—Publications of Bureau of Public Health Education	
New York Medical Journal	New York Med. Jour.
Office international d'hygiène publique	Office internat. d'hyg. pub.
Pacific Coast Journal of Nursing, The	Pacific Coast Jour. Nursing
Paris médical	Paris méd.
Pharmaceutical Journals—American and Foreign. (This heading includes all periodicals reviewed for the Digest of Comments on the Pharmacopœia of the United States of America and on the National Formulary. The names of these periodicals when they appear will be written in full.)	

Title of Periodical	Abbreviation
Physiological Abstracts	Physiol. Abstr.
Policlinico, Il	Policlinico
Political Science Quarterly	Pol. Sc. Quart.
Power	Power
Presse médicale	Presse méd.
Proceedings of the American Society of Civil Engineers	Proc. Am. Soc. Civ. Eng.
Proceedings of the Royal Society of Medicine	Proc. Roy. Soc. Med.
Procès verbaux de chaque séance de la Société des ingénieurs civils de France	Proc. verb. d. chaque séance de Soc. ingen. civ. de France
Progrès médicale, Le	Progrès med.
Public Health	Pub. Health
Public Health Journal, The	Pub. Health Jour.
Public Health Nurse, The	Pub. Health Nurse
Quarterly Journal of Economics, The	Quart. Jour. Econ.
Quarterly Journal of Experimental Physiology	Quart. Jour. Exper. Physiol.
Quarterly Journal of Medicine, The	Quart. Jour. Med.
Quarterly Publications of the American Statistical Association	Quart. Pub. Am. Statis. Assn.
Revue de chirurgie	Rev. de chir.
Revue d'hygiène et de police sanitaire	Rev. d'hyg.
Revue de médecine	Rev. de méd.
Revue générale d'ophtalmologie	Rev. gen. d'opht.
Riforma medica, La	Riforma med.
Rivista di ingegneria sanitaria	Riv. di ingegner. san.
Safety	Safety
Safety Engineering	Safety Engin.
Science	Science
Social Hygiene	Soc. Hyg.
State Boards of Health: Reports, Bulletins, Irregular Publications.	
State Boards of Labor and Industries: Reports, Bulletins, Irregular Publications.	
Surgery, Gynecology, and Obstetrics with International Abstract of Surgery	Surg., Gynec. and Obst.
Survey, The	Survey
System	System
Therapeutische Monatshefte	Therap. Monatsh.
Therapie der Gegenwart, Die	Therap. d. Gegenw.
Transactions of the American Society of Municipal Improvements	Tr. Am. Soc. Munic. Improv.
Transactions of the Canadian Society of Civil Engineers	Tr. Canad. Soc. Civ. Eng.
Transactions of the Medico-Legal Society of London	Tr. Med.-Leg. Soc., Lond.
United States Bureau of Labor Statistics, Monthly Labor Review	U. S. Bur. Labor Statis., Month. Labor Rev.
United States Bureau of Mines, Bulletins, Circulars, and Technical Papers	U. S. Bur. Mines, Bull., Circ., Tech. Papers
United States Department of Labor, Bulletins and Annual Reports	U. S. Dept. Labor, Bull., Ann. Rep.
United States Naval Medical Bulletin	U. S. Nav. Med. Bull.
United States Public Health Service, Hygienic Laboratory Bulletins	U. S. Pub. Health Ser., Hyg. Lab. Bull.
United States Public Health Service, Public Health Bulletins	U. S. Pub. Health Ser., Pub. Health Bull.
United States Public Health Service, Public Health Reports	U. S. Pub. Health Ser., Pub. Health Rep.
Vierteljahrsschrift für gerichtliche Medizin und öffentliche Sanitätswesen	Vrtljschr. f. gerichtl. Med.
Virchow's Archiv für pathologische Anatomie und Physiologie und für klinische Medizin	Virchows Arch. f. path. Anat.
Wiener klinische Wochenschrift	Wien. klin. Wchnschr.
Zeitschrift für experimentelle Pathologie und Therapie	Ztschr. f. exper. Path. u. Therap.
Zeitschrift für Hygiene und Infektionskrankheiten	Ztschr. f. Hyg. u. Infektionskrankh.
Zeitschrift für klinische Medizin	Ztschr. f. klin. Med.
Zeitschrift für orthopädische Chirurgie	Ztschr. f. orthop. Chir.
Zeitschrift für physiologische Chemie (Hoppe-Seyler's)	Ztschr. f. physiol. Chem.
Zentralblatt für innere Medizin	Zentralbl. f. inn. Med.

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SUBJECT HEADINGS FOR ABSTRACTS

Material abstracted for THE JOURNAL OF INDUSTRIAL HYGIENE will be classified under the following subject headings:

1. General.
2. Systemic Occupational Diseases: Occurrence, Treatment, and Prevention. Central Nervous System, Blood, Circulation, Lungs, Kidneys, Alimentary Tract.
3. Poisonous Hazards and Their Effects: Gases, Chemicals, etc.
4. Dust Hazards and Their Effects.
5. Occupational Infectious Diseases: Occurrence, Treatment and Prevention.
6. Occupational Affections of the Skin and Special Senses.
7. Industrial Accidents: Injuries, Burns, etc.: Occurrence, Treatment and Prevention.
8. Fatigue and Occupational Neuroses.
9. Nutrition.
10. Hazards of Compressed Air, Diminished Pressure, Generation and Use of Electricity, and Electrical Welding.
11. Heat, Cold and Humidity.
12. Women in Industry.
13. Industrial Sanitation: Illumination, Ventilation, Heating, Water Supply, Sewage Disposal.
14. Medical Dispensaries and Hospitals in Industrial Plants.
15. Industrial Nursing.
16. Industrial Personal and Community Hygiene: Housing, etc.
17. Industrial Investigations and Surveys.
18. Industrial Management in Its Health Relations: Special Tests in the Selection of Employees.
19. Industrial Service and Mutual Benefit Associations.
20. Industrial Health Legislation and Court Decisions: Malingering.
21. Workmen's Compensation and Insurance.
22. Safety Devices.
23. Rehabilitation of Disabled Employees.
24. Industrial Mortality and Morbidity Statistics.
25. Miscellaneous.

ABSTRACTS *of* CURRENT LITERATURE

OF

INDUSTRIAL HYGIENE

GENERAL

PROGRESS IN INDUSTRIAL HYGIENE AND MEDICINE DURING THE YEAR 1918. *F. D. Patterson.* Mod. Hosp., Jan., 1919, 12, No. 1, 31-32.—A brief summary of the progress of industrial medicine and hygiene in seven distinct fields.—Harold A. Bulger.

INDUSTRY AND MEDICINE. *S. D. Hubbard.* Boston Med. and Surg. Jour., Jan. 30, 1919, 180, No. 5, 119-122.—This article is a discourse, calling the attention of the profession to the importance of industrial diseases and conditions. The author considers that the war has severely tested this new field of medical activity and has proved that whole-time medical service in certain factories and establishments is a necessity.—George R. Minot.

HEALTH PROBLEMS OF INDUSTRIAL WORKERS. *J. A. Lapp.* Ann. Am. Acad. Pol. Sc., Jan., 1919, 81, Whole No. 170, 130-136.—The exigencies of the war situation have established new standards for evaluating workers. Rather than eliminate workmen who have been trained at expense to industry and the community, we should make further advances along the lines of protection and of rehabilitation.

One of the most obvious lessons learned from the war, both in this country and in England, has been that a relatively short working day is frequently economical from the standpoint of the individual, the industry, and the community. The War Labor Board has used its influence constantly in the establishment of the eight-hour day. Besides reducing production from day to day, the fatigue of excessive hours undermines the health of the worker, increases lost time due to illness, leads to an inferior quality of production, and is a serious source of accidents.

Not only must the worker be safeguarded in his employment, but proper housing facilities must be provided to protect him from unsanitary conditions. The ultimate solution of the question of housing rests upon coöperative control. As long as society permits unsanitary houses to exist, some workers will be found who, by choice or necessity, will live in these houses.

Among the more serious menaces to the workers' health in industry are dust, poisons, devitalized air, heat, humidity, and exposure. These hazards vary according to the type of men subjected to them. Where they cannot be eliminated, every effort should be made by the employment department to select men who are constitutionally fitted to combat the dangers to which they are exposed. Not only should men be protected in this way, but where they have succumbed through accident or loss of health, provision should be made for returning them to safe and profitable employment as soon as their physical condition permits.

Since women have taken a permanent place in industry, special scientific inquiries have been undertaken regarding their needs. Among these are: (1) special effects of industrial poisons; (2) the peculiar effect of bad posture; (3) effects of fatigue upon women not found in the case of men; (4) unusual hazards of heat, dust, humidity, devitalized air, and weather exposure.

What has been said of selection in employment of men and women is even more obviously true in the case of children. Since the prohibition of child labor has become almost universal in this country, we are ready to take a second step. Vocational guidance should not only take into account the individual's aptitude for certain kinds of work, but also his physical ability to pursue this work over a long period of time without the serious depletion of his physical resources.—Charles H. Paull.

RECONSTRUCTION OF THE FACTORY MEDICAL SERVICE. Brit. Med. Jour., Jan. 25, 1919, No. 3030, 109.—The Incorporated Association of Certifying Surgeons has issued a report on the Reconstruction of the Factory Medical Service, suggesting points in which the efficiency of that service may be increased. The two points of the system have been individual medical examination and practical knowledge of the conditions of employment. In the past there has been an impairment of the usefulness of the service because the examinations of young people have not been followed up with a view to securing practical results. The report recommends the formation of a well equipped medical department to carry on the executive and administrative work. This should be in charge of a single officer with other medical inspectors, and together with the entire factory department should be under the Ministry of Labor. It further recommends that the Labor Exchanges be made into adjuncts to medical examination by securing employment suited to the physical condition of young persons. In order to secure this it is suggested that the heads of schools secure from the parents of children the type of labor desired and that the Director of Education forward to the Director of the Exchange particulars respect-

ing the school medical history, the educational standard and the date of birth. An employment ticket would then be issued giving name of firm, nature of employment, any fresh physical defects and conditions attached to certificate of fitness. The certifying surgeon would fill this out and file it with the Labor Exchange. This would be done with each change of employment. Inspectors for each exchange would visit factories and see that conditions were carried out. Other provisions deal with the extension of national insurance to young persons of 14 and 15; greater efficiency in dealing with industrial diseases and poisoning and the granting of certificates under the Workman's Compensation Act.—William E. Brown.

The Engineering of Man Power. Mech. Engin., Jan., 1919, 41, No. 1, 27.—Keynote sessions of the Annual Meeting of the American Society of Mechanical Engineers. Papers and addresses of vital interest.—Gordon M. Fair.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

CENTRAL NERVOUS SYSTEM

Eliminating the Epileptic from the Navy. *L. E. Bisch.* U. S. Nav. Med. Bull., Jan., 1919, 13, No. 1, 5-16.—Minor points in history and examination that are suggestive of epilepsy are listed, as well as the results of following up these points, and a table of symptoms and signs of epilepsy in the cases seen by the author.—Charles C. Lund.

CIRCULATION

Cardiovascular Examinations of Fifty-Five Thousand Recruits. *G. E. Fahr et al.* Jour. Am. Med. Assn., Jan. 18, 1919, 72, No. 3, 162-169. —The importance of cardiovascular disease is vividly emphasized in the opening paragraph of Fahr's report. He cites the facts recently brought out in England that out of 350,000 men in the British army, discharged and pensioned for wounds and diseases, a little over 10 per cent. were for heart disease and about 11 per cent. for chest complaints and tuberculosis. Since many men have been put in deferred classes in the army on account of heart disease, it is undoubtedly a more serious cause of disability than tuberculosis. There have been two and one-half times as many pensions for heart disease in the British army as there have been for loss of limbs, and nearly twice as many as for nervous diseases, shell shock and epilepsy together.

Findings

All cases had passed through local boards before subjection to these examinations.

1. The incidence of aortic insufficiency in Texas and Oklahoma is about 0.1 per cent. for men between 21 and 31. Most of these cases were due to polyarthritis, and since experience has always shown that aortic lesions offer a bad outlook if hard physical work is to be done, these were excluded.

2. Uncomplicated mitral insufficiency of endocarditic origin is comparatively rare, being probably not much greater than 0.1 per cent. for men between 21 and 31.

3. Accidental murmurs at the apex are very common, about 3 per cent. of all men showing them, and they are of practically no significance unless accompanied by signs of hypertrophy and increased pulmonic pressure. The greater part of these accidental murmurs were systolic. Two and one-half per cent. were loudest at the apex; 0.6 per cent. over the second left intercostal space. The fact that these accidental and harmless murmurs are frequently rough in character is emphasized.

4. Mitral stenosis, idiopathic hypertrophy and other conditions, such as heart block, were very rare.

5. Neurocirculatory asthenia (irritable heart) is the most important cardiovascular disease in our army. At least 0.5 per cent. of all drafted men should be rejected for this condition before the various divisions sail for France.

Rapid heart draws the attention of the examiner of these men. This is either induced by very moderate exercise or occurs before exercise as a result of the imminence of the examination.

Pulse rates are taken first standing, then recumbent. The recruit then hops 100 times on one foot, and pulse rates are taken at once and two minutes later, in both instances with the man recumbent. Normal men mind such a test very little, their pulse rate returning to within a few beats of normal in two minutes. The circulatory asthenic does not do so and often shows dyspnœa, cyanosis and a general poor "come back" which lasts some time.—Cecil K. Drinker.

Effect of Cardiac Distress on the Work of Recruits. *G. E. Hein.* Jour. Am. Med. Assn., Jan. 25, 1919, 72, No. 4, 249-252.—Hein brings out the fact that the patients giving trouble in examination are not those with organic valvular defects, but they are the men complaining of some dyspnœa or cardiac pain, showing a rapid pulse, a poor response to exercise, often blue, cyanotic hands and feet, profuse sweating, especially in the axillæ, a coarse, irregular tremor and apparently little change in the heart. If such men are accepted as a result of first examination they usually find their way back to cardiac examiners before many weeks. Hein has examined 300 such men who were returned as unable to perform full military duty. Of this number fifty-one were found to have definite physical defects, as hypertension and hypertrophy, etc. The remaining 239 belonged to a large group showing persistent tachycardia. In this group the number of alcohol and tobacco users was high. Eighty-six of these showed thyroid enlargement. Previous sedentary occupations seemed to have nothing to do with the development of symptoms. The total number of cases showing concomitant cardiac and neuro-psychiatric symptoms is not given, but is referred to as considerable.—Cecil K. Drinker.

Cardiovascular Examinations of Recruits at Camp Lewis Mustering Office, April 20 to October 1, 1918. *D. Cass.* Jour. Am. Med. Assn., Jan. 25, 1919, 72, No. 4, 248-249.—Examinations

are recorded for 30,697 men carried out by boards of medical officers in two groups known as preliminary and refer examiners.

The preliminary examinations are of most interest industrially. Recruits in groups of forty were placed in charge of five examiners. Each officer examined eight men, noting the location and character of the apex impulse and auscultating at all four valvular areas. The men were then exercised, bending forward and touching the floor forty times, keeping the knees stiff. This exercise was fairly severe and noiseless and usually caused men with real cardiac defect to drop out without being subjected to serious drill. In all cases in which an abnormally high pulse rate was noted after exercise or in which undue dyspnea and faintness were observed, the examiners were called and passed final judgment. It is of interest to note that on the basis of the careful methods used, 1,298 individuals with mitral regurgitation were accepted for full duty between July 20 and October 1 out of the 30,697 individuals examined, and that in the same group the diagnosis of irritable heart was made only forty-five times.—Cecil K. Drinker.

A Pulse Rate Standard for Recruits. *T. Addis.* Jour. Am. Med. Assn., Jan. 18, 1919, 72, No. 3, 181-185.—The author and his associates on the cardiovascular board at Camp Lewis, Washington, felt the need of more definite standards for pulse rate change after the ordinary exercise of hopping 100 times on one foot.

The method for getting such standards is given in detail, together with a limited amount of practical material, but, as is said, this is too slight to give definite information as to the value of the standards set up.—Cecil K. Drinker.

Physical Exercises in Use in the Cardiovascular Service. *B. Smith.* Jour. Am. Med. Assn., Jan. 11, 1919, 72, No. 2, 103-107.—Gives details and photographs concerning exercises which may be used for the "training" or treatment of soldiers with irritable heart.—Cecil K. Drinker.

LUNGS

The Danger of Tuberculosis in Industrial Establishments. *E. Tedeschi.* Ig. Mod., 1918, 11, No. 6, 126-130.—The government of Italy has made great efforts to prevent and eradicate tuberculosis in the army, but has neglected this work in the industrial establishments. Workmen infected with tuberculosis are frequently found working in factories where they form a source of infection for their fellow-workmen. Since the government has introduced compulsory sickness insurance in the auxiliary war establishments, and is about to extend this insurance to all factories, it is of the highest interest to the state to keep these establishments clear from tuberculosis. The employment of tuberculous workingmen is due to various causes. Frequently men who have been rejected from the army on account of "weakness" hide under this weakness a latent tuberculous process and yet, under the stress of circumstances, are given work. Others who had previously been free from tuberculosis are infected during their work, but keep their condition secret from the factory physician. In many cases strong and healthy men who had always lived in the open air are employed in protracted night work to which they are unaccustomed and sooner or later take tuberculosis. A close supervision of the men and a careful examination on their entering the service would greatly reduce the number of tuberculous cases in factories. In this work the general practitioners should coöperate with the factory physicians.—Albert Allemann.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Contributions Regarding the Toxic Action of Aromatic Nitro-Compounds. *H. Ilzhofer.* Arch. f. Hyg., 1918, 87, No. 5/6, 213-231.—The clinical effects of various nitro-compounds met with in the explosive industries have been recently studied in large numbers of cases by Kölsch, and the present paper reports the results of collaborative tests on animals with trinitroxylol, trinitrophenol or picric acid and trinitroanisol. Tests were made on cats and a few rabbits and were frequently interrupted by a scarcity of animals. The test substances were given by mouth in ascending doses from 0.5 to 2 gm., per kg. body weight, in aqueous acacia suspension, in lemonade and in 20 per cent. alcohol, and were applied to the shaven skin and injected subcutaneously.

Trinitroxylol, which is almost insoluble in cold alcohol and insoluble in water, produced no decided toxic symptoms regardless of the method of internal administration, except some loss of weight and decreased appetite. Locally it merely yellowed the skin. Apparently nitrobenzol is rendered less toxic by the introduction of one CH_3 group in nitrotoluol, and non-toxic by the two CH_3 groups of trinitroxylol. The lack of toxic action is also due in part to its insolubility.

These results agree with the almost complete lack of records of trinitroxylol poisoning in industry.

Picric acid, readily soluble in water and more so in alcohol, produced marked toxic symptoms in animals. Symptoms produced were loss of appetite, loss of weight, weakness, evidences of pain and death in three days after the dose reached 2 gm. per kg. Autopsy showed brownish-yellow swelling of the gastric mucosa, congestion of the liver and kidneys, with more or less staining, and picric acid in the urine. Methemoglobin was never found *in vivo* or after death as has been reported in man. Inhalation of fumes and dust caused intense irritation of the mucosæ and rapid, labored respiration, but the animals recovered completely on removal from the picric atmosphere. Skin applications caused staining of the skin and hair, but no constitutional symptoms. Subcutaneous injections of 0.2 to 0.3 gm. per kg. proved fatal in twenty-four hours, but without methemoglobin formation. Doses of picric acid proved toxic when equal doses of nitroxylol, nitrotoluol and nitronaphthalin were harmless.

Severe damage to health was not observed in man and tolerance seems to be relatively great. Various mild disturbances have been noted in individual workers, such as staining of skin and hair

and more or less irritation of the skin and mucous membranes.

Trinitroanisol, much more soluble in alcohol than in water, proved toxic sooner and in smaller doses when given in alcohol. Experimental animals died after four weeks when the dose was given in water, with the same postmortem findings as for picric acid. Skin applications caused severe purulent dermatitis. No cases of general poisoning from trinitroanisol in industry are recorded, but its use is only of very recent date. Most workers complain of painful moist pustular eczemas with itching and often with inflammatory swellings of the lymph glands. In addition many suffer with a general indisposition, headache and loss of appetite.

Skin sensitiveness and inflammations of the conjunctival, pharyngeal and laryngeal mucosæ are the only lasting results noted.

Trinitroanisol is less toxic than picric acid, due in part to the CH_3 group and in part to its decreased solubility, but is more irritant to the skin.

As precautionary measures susceptible persons should be excluded from the industry and workers should change their working garments frequently and practice strict cleanliness of person.—Henry F. Smyth.

An Investigation of the Detoxication of Methyl Alcohol. *J. Pohl.* Arch. f. exper. Path. u. Pharmakol., April, 1918, 83, No. 3 4, 204-220.—The author mentions the well-known, relatively slow rate of oxidation and excretion of methyl alcohol in comparison with ethyl alcohol. Methyl alcohol in dilute solution was injected into the peritoneal cavity and intravenously to insure complete absorption. After varying intervals of from twenty-four to seventy-two hours the animals were killed and the amount of alcohol, remaining in various tissues and removable by distillation, was determined by the bichromate method, control experiments having shown the method to be satisfactory. Relatively large amounts were found in the blood, the muscles, and the liver, but only a very little could be recovered from the brain. Other experiments suggested that the brain may destroy methyl alcohol readily. Nevertheless, Pohl does not ascribe the small amounts of alcohol to be found in the brain to this destructive action, but rather to the lack of any special affinity of the brain for the poison. This, then, would suggest that methyl alcohol has a selective poisonous effect upon nerve tissues which is produced by relatively small amounts, whereas muscle tissues and the liver, in comparison, are little damaged by very much greater concentrations.

A second part of Pohl's paper relates his attempt to lessen the concentration of methyl alcohol in the tissues. Bleeding, the introduction of salt solutions into the blood, and the absorptive power of charcoal when buried under the skin were found to accomplish this.—Worth Hale.

Poisoning through Inhalation of Ethylmercaptan. *K. Pichler.* Zentralbl. f. inn. Med., Oct. 26, 1918, 39, No. 43, 689-693.—Through the accidental leakage of a tube containing ethylmercaptan in the chemical collection in the high school in Klagenfurt, ten children between 16 and 18 years old working in the next room became ill. Headache, general malaise and abdominal pain were the common symptons. In three cases there was vomiting and diarrhea. Two of the pupils were compelled to omit school for several days. In one case, followed carefully by Pichler, albuminuria with red cells in the urinary sediment persisted for some time. There was no hemoglobinuria.

It was estimated that 3 gm. of ethylmercaptan had escaped from the tube and at least four and one-half days had been available for this evaporation. This occurred in a room next to the one in which the scholars were seated, a single door connecting the two. As the schoolroom had a cubic capacity of 325 square meters, the toxicity of ethylmercaptan is evidently very high.

Pichler is unable to find other cases of poisoning from this compound, but suggests they may have occurred in industrial chemical operations.—Cecil K. Drinker.

Methemoglobinemia Due to Poisoning by Shoe Dye. Report of a Series of Cases at an Army Camp. *R. E. Stifel.* Jour. Am. Med. Assn., Feb. 8, 1919, 72, No. 6, 395-396. A report of sixteen cases of alarming cyanosis coupled with dizziness, visual disturbances, headache and general malaise traced directly to a shoe dye used to darken russet shoes and shown to contain nitrobenzol.

The author, having ascertained through experiments on mice that the dye in question had marked toxic properties, recounts its effects when used upon his own shoes. He dyed these with the preparation and after four hours developed nausea, headache and visual disturbances. Another volunteer cleaned his shoes thoroughly with alcohol and then saturated them with dye. At the end of six hours he became somewhat cyanotic. "In seven hours his lips and finger nails were purple and he looked ghastly." Spectroscopic examination of the blood revealed methemoglobin, but there were no significant morphological blood changes.—Cecil K. Drinker.

Report of a Case of Cyanosis at Camp Jackson, S. C., Due to Poisoning from Shoe Dye. *R. E. Stifel.* Jour. Am. Med. Assn., Jan. 22, 1919, 72, No. 8, 592-593.—A further case of shoe dye poisoning attributable to nitrobenzol, bringing out the fact that russet shoe dye, even when guaranteed odorless, can produce cyanosis. Shoes dyed should not be worn for three or four days. The orange cleaning fluids and russet pastes for polishing are apparently entirely harmless.—Cecil K. Drinker.

Anilin, Rather than Nitrobenzene, as the Poison in Shoe Dye. *W. G. Hudson.* Jour. Am. Med. Assn., March 8, 1919, 72, No. 10, 747.—A letter to the journal commenting upon the above communications. (See preceding abstracts.) The effects of both nitrobenzene and anilin are quite similar, but the nitro compounds are more likely to cause hemolysis and to make the blood present the appearance of chocolate. Anilin is more likely, at least in its earlier stages, to cause the dark color described in the above cases. Anilin is quicker in its action, more quickly recovered

from, and shows a particular predilection for penetrating leather rapidly and for poisoning by skin absorption. Special precautions must therefore be taken regarding the shoes worn by anilin workmen. Both agents will cause cyanosis.

Nitrobenzene is widely used as a cheap perfume and was probably present in the preparation used in these cases. Anilin, however, was also probably present in larger proportion, as a solvent or mordant for the dye.—C. K. Drinker.

DUST HAZARDS AND THEIR EFFECTS

Experiments on the Effects of Dust Inhalation. *A. Mavrogordato.* Jour. Hyg., Oct., 1918, 17, 439-459.—The author undertook to determine experimentally the reaction and behavior of the lungs to a variety of dusts, some known as harmless and others as dangerous. The dusts studied were coal and shale—known to be harmless—flint and quartz—known to be dangerous—dusts from the flues of furnaces, and pure silica.

Series of guinea pigs were exposed to moderate clouds of the various dusts for two hours a day for twelve consecutive days. Animals from each series were killed upon the completion of the experiments, *i.e.*, after periods of one week, three weeks, three months, and one year, and the lungs were examined.

The results showed that the harmless dusts, such as coal and shale, readily invade the lungs, where they set up a catarrhal condition. The cells which take up the dusts are quickly shed and are eliminated. The dangerous dusts, on the other hand, do not set up any catarrh; the cells which take up these dusts remain fixed and form plaques and areas of fibrosis.

Of extreme interest were experiments in which two sets of guinea pigs were exposed to flint dust and to a mixture of flint and coal dust. It was found that the catarrhal reaction set up by the coal dust helped to clear the lungs of the flint dust, so that the lungs of the guinea pigs exposed to the mixed dust cleared themselves more quickly than when exposed to the flint dust alone.

The author concludes from his experiments that the harmless dusts are those which produce a marked initial reaction with shedding of the epithelium, resulting in the rapid elimination of the dust from the lungs. The dangerous dusts are those which do not produce any initial reaction and which consequently accumulate in the lungs. Dusts that produce an initial reaction tend to carry out with them dust that is inert.—Harry Linenthal.

Wood Dust—Its Effect on Health. *R. P. Albaugh.* Ohio Pub. Health Jour., Jan., 1919, 10, No. 1, 14-17.—Contrary to the opinion of some employers, the inhalation of wood dust is undoubtedly a menace, as is evidenced by the unusually large labor turn-over and the large percentage of deaths due to tuberculosis in workers inhaling wood dust. Its action as a predisposing cause to tuberculosis is not the only danger involved. Other detrimental features are: (1) The carrying of infection, (2) the irritation of the respiratory and digestive tracts, (3) the cutting off of light, (4) the danger of fire from the accumulation of wood dust and shavings, (5) the danger of accident from slipping on sawdust or stumbling over accumulations, (6) actual poisoning by certain types of wood which contain active principles known to be poisonous. The prevention of wood dust can be accomplished by proper exhaust systems.—Hazel Andrews.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

The Epidemiology of the Sputum-Borne Diseases and Its Relation to the Health of the National Forces. *E. B. Vedder.* Mil. Surgeon, Feb., 1919, 44, No. 2, 123-153.—The sputum-borne diseases are of greater importance than the venereal diseases or than insect-borne diseases to the health of the national forces. Of the sputum-borne diseases, tuberculosis is of relatively less importance because, in general, infection is contracted before entering the camps. The prevention of lobar pneumonia is especially important because of a high mortality, which has not been greatly reduced under the modern methods of treatment. The problem of pneumococcus carriers and their relationship to the occurrence of pneumonia is very great. Primary bronchopneumonia has been relatively unimportant. The admission rate for influenza and bronchitis combined has been greater than for venereal diseases. Articular rheumatism, other than chronic joint inflammations, and cardiac affections and general septicemias following tonsillitis make tonsillitis an important sputum-borne disease. The admission rate for measles was high and the mortality higher than that for any other disease. Deaths were due to complicating pneumonia. Special measures are recommended to prevent measles. Mumps has not been important because incident rate has not been great and its mortality practically nil. Scarlet fever is a more serious disease but is relatively unimportant because it is comparatively infrequent and cases tend to be sporadic. Whooping cough is practically non-existent in the army. Diphtheria has been unimportant. Cerebrospinal meningitis is important because of its high mortality and the disabling complications which so frequently occur, although there are relatively few cases. The epidemiology is not clearly understood, but indications are that its spread is due exclusively to carriers. Relatively few seem to be susceptible. Carriers seldom develop meningitis themselves. Important factors which enter into the development of the disease are fatigue and exposure to cold. These same factors are also of the greatest importance in the development of the other sputum-borne diseases.

Sputum-borne diseases are caused directly by the transfer of infectious sputum from the infected to the non-infected individuals, and cold and fatigue are important predisposing causes. One of the chief factors which favors the transfer of infectious sputum is the overcrowding of men. Measures to prevent this are discussed. Spitting should be prohibited by order and the order enforced. Education of the men is important. The common drinking cup is rarely met with and should be entirely abolished. Measures taken to prevent undue fatigue and exposure to cold are discussed. Excessive dryness of the air makes the inhabitants of a room more susceptible to the cold and the increased abstraction of water from the respiratory passages leaves them dry and irritated and thus lowers the protective action of the mucous membranes. Protective vaccination against pneumonia gives hope of success, but it does not appear probable that a vaccine could afford protection against streptococci. Meningococcus vaccines have been tried, but it is difficult to obtain information concerning their efficacy.

"The more the subject is considered, the more the emphasis is placed upon the importance of the general methods proposed for the reduction of all the respiratory or sputum-borne diseases, particularly an increase in floor space for each soldier and the conservation of the body heat."—Harold A. Bulger.

The Seymour-Jones Sublimate-Formic Acid Method for the Disinfection of Anthrax-Infected Furs and Skins. *V. Gegenbauer.* Arch. f. Hyg., 1918, 87, No. 7/8, 289-315.—Gegenbauer, after an exhaustive series of tests with the Seymour-Jones method of hide disinfection for anthrax, using the originally suggested amounts of chemicals (0.02 per cent. mercuric chloride in 1 per cent. aqueous solution of formic acid), and time of exposure (twenty-four hours at 20 C.), and increasing amounts and time intervals, arrives at the following conclusion: A thorough testing of the method shows that with the concentrations suggested and also with greater concentrations within reasonable limits, there is no sure disinfection of anthrax-infected pelts and skins produced within any practical time limits.—Henry F. Smyth.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Occupational Cancer. *H. C. Ross.* Jour. Cancer Research, Oct., 1918, 3, 321-356.—A government investigation of pitch cancer at briquette works in South Wales has brought to light clinical evidence suggesting that a definite, though not specific chemical rather than mechanical action has to do with the causation of cancer. The investigation was extended to other commodities, whose use may give rise to cancer, such as coal tar, pitch, soot, petroleum, petrolatum, grease and tobacco. The study showed that the greater the mechanical irritation produced by these commodities, the less was the cancer incidence. It is suggested that organic nitrogenous substances of a group common to all the above substances may be the specific chemical agents responsible for occupational cancer. In coal tar carbonization commodities it is essential that the coal be bituminous.

An effort was made to find the substance. Clinical facts ruled out previous hypotheses as starting points for the experiments undertaken. The working hypothesis adopted was that cells divide in response to stimuli from without. Hence reproduction of cells is encouraged by cell death among their neighbors, cell death setting free the amino substances which excite cell division among surviving cells. The cells producing cell division are called *auxetics.* These were found in many of the investigated commodities. When artificially introduced into animals, they produced proliferations amounting to benign tumors. Lack of methods precludes, of course, the possibility of proving in human beings that this is the way in which predisposition is acquired.—William Herman.

Ear Protection. *G B. Trible* and *S. S. Watkins*, U. S. Nav. Med. Bull., Jan., 1919, 13, No. 1, 48-60.—An article showing the comparative efficiency of various devices in common use for protection of the ears from damage by detonations and poison gases. The paper is based on a series of experiments along various lines.—Charles C. Lund.

FATIGUE AND OCCUPATIONAL NEUROSES

Remarks Concerning the "Work Hygiene Researches" of W. Weichardt and H. Lindner. *E. Weber.* Arch f. Hyg., 1918, 87, No. 5/6, 207-212.—The findings reported by Weichardt and Lindner using Weber's method of studying fatigue by means of the plethysmographic "Work Curve" are referred to and criticized, but are not given in sufficient detail to make criticism very intelligible without reference to the original articles in the *Monatschrift für öffentliche Gesundheitspflege*, 1916, No. 2, and the *Archiv für Hygiene*, Vol. 86, No. 2/3. Weber considers their conclusions too sweeping and generalized and not fully supported by their published results. He questions the statement that old age is of itself responsible for a negative work curve, and he accepts with reserve their findings of a negative curve in school children after morning lessons, claiming that they have not excluded the pathologic influence of anemia. He thinks that their results may have been vitiated by errors in technic, which are only avoidable in such difficult subjects by prolonged practice with the method and careful review by skilled observers. He recommends in such cases, and always where the effect of intellectual effort is to be studied, that tests be made with the subject reclining as well as sitting. Especially in difficult cases Weber prefers the more sensitive

instrument of Lehmann to that of Kronecker.—Henry F. Smyth.

The One-Break Day. Editorial. Eng., Jan. 3, 1919, 107, No. 2766, 19-20.—Gordon M. Fair.

INDUSTRIAL ACCIDENTS: INJURIES, BURNS, ETC.: OCCURRENCE, TREATMENT AND PREVENTION

Coke-Oven Accidents in the United States during 1917. *A. H. Fay.* U. S. Bur. Mines, Tech. Paper 206, 1918.—An eighteen-page pamphlet of statistics relating to fatalities and injuries in bee-hive and by-product coke-ovens, and one table for coal mines. A list of papers published by the Bureau of Mines dealing with allied subjects is appended.—C. K. Reiman.

NUTRITION

The Vitamines in Green Foods. *B. Osborne* and *L. B. Mendel.* Jour. Biol. Chem., Jan., 1919, 37, No. 1, 187-200.—A comparison of the quantities of water soluble and fat soluble vitamines in spinach and cabbage leaves, alfalfa, clover and timothy plants. It seems that the green vegetables supply an important addition to the diet because cereals, meats, potatoes, fats, and sugar probably furnish too little of either of these vitamines to meet fully the requirements of an adequate dietary.—Alfred C. Redfield.

The Antiscorbutic Property of Vegetables. I. An Experimental Study of Raw and Dried Tomatoes. *M. H. Givens* and *H. B. McClugage.* Jour. Biol. Chem., Feb., 1919, 37, No. 2, 253-270. —In experiments planned to determine the antiscorbutic potency of different foods and the effect of preservation upon this property, it is found that fresh tomatoes are efficient antiscorbutic agents when added to the diet of the guinea pig. Raw fresh tomatoes dried in a blast of air at either 35 or 40 C. retain a significant amount of their antiscorbutic property.—Alfred C. Redfield.

Influence of High Temperatures and Dilute Alkalies on the Antineuritic Properties of Foods. *Amy L. Daniels* and *Nellie I. McClurg.* Jour. Biol. Chem., Jan., 1919, 37, No. 1, 201-213.—The effects of usual processes of preparation and preservation of vegetables upon their dietary value were studied. In feeding experiments upon rats it was found that the antineuritic vitamine of soy and navy beans autoclaved at 120 C. or boiled with 5 per cent. $NaHCO_3$, and of cabbage raw, boiled at 100 C., autoclaved at 120 C. or boiled with 5 per cent. $NaHCO_3$, was not destroyed. Contrary to the findings of previous investigators, the extracted water soluble vitamine was also unaffected by boiling in alkaline solution.—Alfred C. Redfield.

HEAT, COLD AND HUMIDITY

Effect of Dry Heat on the Blood Count in Animals. *J. B. Murphy* and *E. Sturm.* Jour. Exper. Med., Jan., 1919, 29, No. 1, 1-15.—The blood of mice, rats and guinea pigs shows a sharp fall in the total white count after a short exposure to heat from an electric light. Both the lymphocytes and the polynuclears become diminished. Following this, over a period of weeks, the polynuclears rise progressively and slowly. The lymphocytes at first rise rapidly, and later more slowly. During the time of their rapid increase they may show amitotic division.—George R. Minot.

The Source of the Lymphocytosis Induced by Means of Heat. *W. Nakahara.* Jour. Exper. Med., Jan., 1919, 29, No. 1, 17-23.—Nakahara considers that the pronounced lymphocytosis induced in animals by heat is due particularly to the increased proliferative activity of the germinal centres in the spleen and lymph glands, reacting to the destructive action of heat seen on the lymphocyte cells themselves.

In this same issue of the *Journal of Experimental Medicine* will be found other articles on closely related subjects.—George R. Minot.

WOMEN IN INDUSTRY

Federal Policies for Women in Industry. *Mary Van Kleeck.* Ann. Am. Acad. Pol. Sc., Jan., 1919, 81, Whole No. 170, 87-94.—Although the signing of the armistice has altered the attitude both of the employer and the public toward women in industry, it is probable that a by no means negligible number will continue to work in factories. For this reason the writer points out that it is important that we avail ourselves of the experiences, during the war, of various federal agencies in determining conditions of employment for women.

Among these agencies are the U. S. Railroad Administration, War Labor Conference Board, Quartermaster's Department, War Labor Policies Board. Shortly after the signing of the armistice, the Woman in Industry Service of the Department of Labor, with the approval of the Secretary of Labor, issued a statement of standards for guiding the employment of women in peace times. These standards provide:

(1) That no women shall be employed more than eight hours in any day or more than forty-eight hours in any week; that there shall be a half holi-

day on Saturdays; that there shall be one day of rest in seven; that at least three-quarters of an hour shall be allowed for meals; that rest periods shall be allowed during the day; and that no women shall be employed between ten P. M. and six A. M.

(2) That equal wages shall be paid for equal work; and that no changes be made in the work in order to justify lower wages for women; that a minimum rate shall be established based upon the cost of living for the worker and dependents.

(3) That comfort and sanitation shall be provided through proper washing facilities, proper and separate toilet facilities, with dressing and rest rooms, adequate cleaning facilities for floors, etc., acknowledged standards of lighting and ventilation, pure and cool drinking water, adequate lunchroom facilities. Only work shall be allotted to women which shall permit them to be seated in comfortable chairs with backs during a portion of the day.

(4) That proper safety and fire precautions must be provided; and first aid equipment should be easily accessible.

(5) That occupations should be selected for women which do not involve undue physical strain through standing or unnatural posture. They should not do work involving the lifting of more than twenty-five pounds, nor should they operate mechanical devices requiring unusual strength. Their work should not expose them to excessive heat, nor to dust or fumes or poisons without proper safeguards. They must not be employed in occupations where the poison risk is greater for women than for men. Proper uniforms with caps and with comfortable shoes are highly desirable.

(6) That no work shall be given out to be done in living or sleeping rooms or in rooms directly connected with them.

(7) That the personnel department have charge of the selection, assignment, transfer, or withdrawal of workers, and that there shall be a woman supervisor for departments employing women. Only workers shall be selected for employment who are physically able to perform the required operations.

(8) That a condition of coöperation shall be encouraged between the management and the employees, so that the machinery for joint negotiation shall exist as it may be needed from time to time.—Charles H. Paull.

The Organization of Women's Work. Riv. di ingegner. san., 1918, No. 1, 3.—The author reviews an article on women's work by H. Joli in *Le Génie Civil.* This question is of great importance to France since it is closely connected with the birth rate which is steadily declining in that country. In order to obviate the ill effects on the birth rate and to reduce infantile mortality, Joli recommends half-day work for women which would permit them to recuperate their strength and to take proper care of their children. He believes that by this system neither the quantity nor the quality of production would be reduced; on the contrary he considers it an indisputable fact that the product of a five-hour work day is better and larger than that of a ten-hour day. In general, women give up factory work after the age of 25, either because their health is impaired or because they desire a change. With a five-hour day they would preserve their strength and would continue to work until they reach the age of 40 or 45.—Albert Allemann.

Regulation of Women's Working Hours in the United States. Am. Labor Legis. Rev., Dec., 1918, 8, No. 4, 339-354.—The topic headings are: Occupations Covered; Standards of Daily and Weekly Hours; Overtime; Prohibition of Night Work; Legal Hours in Different States.—Charles H. Paull.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Industrial Sanitary Equipment Standards. Editorial. Metal Worker, etc., Feb. 7, 1919, 91, No. 6, 165-167.—The Standard Oil Company of New Jersey has recently adopted certain standards to be complied with in the sanitary equipment of the company's plants. The standards regulate the construction equipment, heating and ventilating of toilet rooms and lavatories in great detail. They are reprinted in this article in a slightly modified form.—Gordon M. Fair.

Requirements and Standards for Heating and Ventilating. *W. Nygren* and *R. Hering.* Dom. Engin., Feb. 1, 1919, 86, No. 5, 219-221.—Gordon M. Fair.

Humidity as an Active Factor in Ventilation, and the Value of Window Opening in Fully Occupied Rooms with Small Temperature Difference from Outside Air. *H. Selter* and *A. Esch.* Ztsch. f. Hyg. u. Infectionskrankh., July, 1918, 86, No. 3, 324-332.—Contrary to the generally accepted theory that marked temperature differences between outdoor and indoor air are necessary to secure room ventilation from window opening when there is no wind, Selter and Esch show by laboratory tests that if the room air is more humid than the outer air considerable interchange occurs, in spite of little or no temperature differences. High humidity of room air occurs in fully occupied rooms, such as school rooms, and in many work rooms where hand work is done as well as where the air is artificially humidified, and here window opening is a decided help to ventilation even on quiet summer days.—Henry F. Smyth.

Roof Construction for Factories with Excessive Moisture. *F. J. Hoxie.* Am. Arch., Jan. 29, 1919, 115, No. 2249, 181-187.—Gordon M. Fair.

Factory Heating. *A. King.* Dom. Engin., Feb. 8, 1919, 86, No. 6, 254-257.—Gordon M. Fair.

Modern Factory Heating. *A. G. King*. Dom. Engin. Jan. 4. 1919, 86, No. 1, 27-30 (cont.); Jan. 11. 1919, 86, No. 2, 76-79.—Gordon M. Fair.

Design of Industrial Exhaust Piping Systems. Metal Worker, etc., Jan. 31, 91, No. 5, 144-146.—Gordon M. Fair.

Sanitation in Emergency Shipyards. *W. L. Stevenson*. Jour. Boston Soc. Civ. Eng., Jan., 1919, 6, No. 1. 1-18.—The writer of this paper was associated with the Department of Health and Sanitation of the U. S. Shipping Board organized under the direction of Col. Doane in Nov., 1917. His paper covers the work done by the Department of Sanitary Engineering in the shipyards under the control of the U. S. Shipping Board. Since the shipyard workers were not subject to orders as were the enlisted men in the Army or Navy the work done was exemplary of industrial sanitation on a very large scale. A great deal of education and diplomacy was necessary to bring about among the contractors the understanding that it was essential to the conservation of man-power to safeguard the workers in preventing sickness, injury or loss of vitality. The Department as a whole devoted its efforts to: 1. medical and surgical work; 2. sanitary engineering; 3. work in the extra shipyard zone, in coöperation with the civil, state and federal authorities. The Department of Sanitary Engineering devoted itself to the supply of cool, clean, pure and readily obtainable water; to the sanitary disposal of excreta; to the securing of proper washing facilities for the workers; to the elimination of flies and mosquitoes and relief from vermin. It secured proper eating facilities for the workers and insured cleanliness in the restaurants. It would be interesting to hear of Mr. Stevenson's work in more detail.—Gordon M. Fair.

Sanitary Engineers Get Direct Results in East Indian Mining Camp. *H. N. Jenks*. Engin. N.-Rec., Jan. 23, 1919, 82, No. 4, 172.—How a young American engineer tackled the problem of industrial hygiene and sanitation in an East Indian mining camp in Burma.—Gordon M. Fair.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Successful Health Supervision by a Manufacturing Company. *J. J. Weber*. Mod. Hosp., Jan., 1919, 12, No. 1, 55-57.—The industrial health work of the Norton Company of Worcester, Massachusetts, is summarized.—Harold A. Bulger.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Housing and Transportation Problems in Relation to Labor Placement. *J. Ihlder*. Ann. Am. Acad. Pol. Sc., Jan., 1919, 81, Whole No. 170, 51-55.—A general article on the problems of housing and transportation in their relation to labor. —Charles H. Paull.

Industrial Housing. Editorial. Arch. and Bldg., Jan., 1919, 51, No. 1, 3-5.—Gordon M. Fair.

Housing the Workers—An Unfinished Job. *G. Cove*. Am. City, Jan., 1919, 20, No. 1, 23-25.—The present status of government housing projects—a challenge to local Chambers of Commerce to meet the emergency which Congress is unwilling to face.—Gordon M. Fair.

What Will Become of the Government Housing? *R. S. Childs*. Nat. Munic. Rev., Jan., 1919, 8, No. 1, 48-52.—The question of what disposal should be made of the thirty permanent villages built about war industries is discussed by Mr. Childs. He feels it is an opportunity to try out a "local incorporated association of the tenants in which each householder shall have a vote." Thus the houses would become joint property of the community, and would be controlled by joint action, and there would be no question of industrial paternalism. He feels this to be an "opportunity of trying out in America a social experiment of . . . far reaching and fascinating possibilities." A list of the United States Government's fifty-two principal housing projects and their locations concludes the article. There are a number of other articles in this same issue relating to government housing.—Linda James.

The Present and Future Government of War Communities *E. Cawcroft*. Nat. Munic. Rev., Jan., 1919, 8, No. 1, 52-61.—Linda James.

What About the Government Housing Program? *M. Knowles*. Engin. N.-Rec., Feb. 13, 1919, 82, No. 7, 329-331.—Gordon M. Fair.

Negroes Move North. *G. E. Haynes*. Survey, Jan. 4, 1919, 41, No. 14, 455-461.—Contains a brief discussion of working and housing conditions.—Charles H. Paull.

Boston's Housing Code. Editorial. Survey, Jan. 25, 41, No. 17, 557.—Charles H. Paull.

Town Planning. *T. Adams*. Canad. Engineer, Feb. 13, 1919, 36, No. 7, 215-216.—The factors of nerve power, capacity, concentration and physical endurance of workmen are to be considered the real problem in industrial housing. These things are most valuable to the manufacturer and are destroyed by bad housing conditions.—Gordon M. Fair.

Town Planning in Canada. *J. White*. Canad. Engineer, Feb. 6, 1919, 36, No. 6, 199-200.—Gordon M. Fair.

How Soldiers Were Quartered and Fed in Spruce Production Camps. Engin. N.-Rec., Jan. 9, 1919, 82, No. 2, 105.—Gordon M. Fair.

What Part the Engineer Played in Government Housing. Engin. N.-R., Jan. 16, 1919, 82, No. 3, 147-148.—Report of Mr. John W. Alvord, Chief Engineer of the U. S. Housing Corporation. —Gordon M. Fair.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

Industrial Surveys for Physical Readjustments. *A. B. Segur.* Ind. Management, Jan., 1919, 57, No. 1, 63-65.—Mr. Segur, Industrial Engineer of the Red Cross Institute for the Blind, outlines the method of investigation which his department follows in determining occupations satisfactory for blind workers. The questionnaire method of conducting surveys is quite unsatisfactory from the standpoint of the Red Cross Institute for the Blind, since: (1) most firms either do not answer questionnaires at all, or their answers are of a perfunctory nature; (2) there is danger that an employer making a survey of his plant will not include all possible occupations in his report, and will consequently be assured that occupations which he has not mentioned are in no wise adapted to blind workers.

Surveys in order to be satisfactory must take into account (a) the job, (b) every possible handicap, (c) conditions of employment. By following this rule it will be found that there are very few positions in plants which are not adapted to workers with some sort of handicap. On the other hand care should be taken that occupations are not selected for handicapped workers where the cost of their training will be out of proportion to the importance of the operation. Furthermore, a handicapped worker should not be encouraged to take a position where it is probable that he will not be able to maintain the standard of production. Surveys of this character are most satisfactorily conducted by men who have had special training in survey and in industrial work, and who will coöperate with the foremen and the employer, thereby obtaining perspective and intimate, detailed knowledge in a final report.

In making a survey of an industry it is better to study carefully a single representative plant than to visit a large number of plants at haphazard.

Mr. Segur illustrates, by drawings, graphic forms which may be used in summarizing final results of a survey. These charts show how the flow of material may be illustrated, and a brief summary of the mental and physical requirements for each operation given in symbol form. A very important adjunct of the flow of material chart is the promotion chart, which points out the lines of promotion from various operations. By the use of symbols these charts can be cross-referenced, thereby coördinating them accurately.—Charles H. Paull.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS; SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

The Extension of Selective Tests to Industry. *B. Ruml.* Ann. Amer. Acad. Pol. Sc., Jan., 1919, 81, Whole No. 170, 38-46.—In this discussion Mr. Ruml points out that tests used in classifying men according to mental capacities and trade knowledge in the army suggest the development of similar tests in industry. In organizing various army units it was found that certain numbers of men with definite occupational knowledge were needed. In order to properly fill these positions two forms of tests were employed: the intelligence test and the trade test. A "qualification card" was prepared for each man tested. On this card were recorded his physical, mental, educational, and technical qualifications as determined by the physical examination, an interview, the intelligence test, and the trade test. The fact that the physical examination and the interview are relatively common procedures in employment management leads the writer to omit any detailed discussion of them. The army intelligence tests were devised to give a general idea of the individual's mental alertness. Conditions in the army made it imperative that the tests be given at great speed, that they be scored by a staff which was changing, and that the tests be applicable both to men who understood and who did not understand English.

Three sets of tests were therefore necessary. The first applied to men who could speak English, and could be given to large groups at one time. The second was given to men in groups who could not read English. The third group of tests was given to individuals where one of the other tests seemed to indicate that an unusual mental condition existed. All the group tests were so arranged that it was unnecessary for the soldier to write any words. He indicated his judgment by means of digits, check marks, and underscorings. Because of the definiteness of the tests it was possible to divide men into groups on the basis of their results. The very superior group was classified as A; those of decidedly better ability were B; those of average ability C+, C, and C—; inferior types were marked D and D—; and where arrested mental development was indicated the rating was E. The lowest rating was always checked by an individual examination. The ratings were of value in three ways: (1) they offered a basis for eliminating undesirables; (2) they indicated men of superior ability who sooner or later would become candidates for promotion; (3) they allowed an equalization of abilities in different companies of a regiment.

The application of intelligence tests in industry should produce results analogous to those obtained in the army. An employment manager who informs himself of the intelligence requirements of jobs will tend to eliminate the misfit element by intelligence tests. The intelligence tests, furthermore, should be of value during slack times in selecting men to be laid off. Again, the tests are

important in selecting workers to develop a new process of manufacture. Where special training opportunities are offered in a company's school, the intelligence tests will assist in selecting candidates for the school. Finally, the intelligence tests will indicate the men of special mental alertness who, although they can perform the task to which they are assigned, should not be expected to remain at dull, routine work.

In organizing the trade tests for the army the work was governed by the same procedure as that outlined under intelligence tests. It was necessary that these tests should give an accurate index of the occupational skill of the individual, regardless of what part of the country he came from. This uniformity of rating was absolutely essential. In developing the tests the trade was analyzed to ascertain the kind of work done, and at the same time to discover bits of information or terms characteristic of the particular trade and of no other. In this way tests were developed which, though given rapidly, would determine the degree of knowledge which the individual possessed concerning a particular job.

In applying the trade tests to industry they can be used in three ways: to assist in hiring, transferring, and training. In hiring they determine whether the workman has the knowledge qualifications for the job. In transferring they determine whether he is qualified to undertake different work. As in the case of the intelligence tests they assist in selecting workers who shall be laid off in dull times. In conjunction with the intelligence tests the trade tests are also serviceable in determining whether a worker shall be given educational opportunities. Trade tests tend to establish standards of production which can be more definitely maintained than those based upon individual judgment, which may vary in different persons and at different times.

In developing intelligence and trade tests for industries it must be borne in mind that the purpose is different from that which brought the army tests into existence. Furthermore, only competent individuals should be entrusted with this work. They should appreciate not only the value of the tests but their logical limitations.—Charles H. Paull.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

Installing Employment Methods. *W. A. Sawyer.* Ind. Management, Jan., 1919, 57, No. 1, 7-11.—Dr. Sawyer in his discussion presents an outline of certain phases of personnel work as it has been developed in the American Pulley Company. He points out that there are two forms of compensation for labor: (1) wages; (2) conditions of employment, including attractiveness of surroundings, harmony and smoothness of organization, etc. While the American Pulley Company has attempted to keep pace with the increase in the cost of living, it has at the same time endeavored to add to its organization features belonging in the second class. In order to assist new employees in adapting themselves to plant conditions special attention is given them when they enter the plant. After the new man has been assigned to his locker, he is taken to the foreman and given a personal introduction. While certain difficulties have arisen in obtaining the desired response from the foremen, the company will undoubtedly discover a form of procedure which will be mutually satisfactory. In some departments instructors are provided for new workmen, and a definite effort is made to follow their progress in order that adjustments may be made where men are not fitted for the particular work assigned them.

To provide for the special comfort of workmen a substantial service building has been erected, containing lockers, shower baths, lavatory, play roof, and solarium. This building has been used constantly by the workmen, who appreciate its conveniences.

In order to develop thrift among the workers and to give them a personal interest in the plant, an insurance and stock sharing plan was introduced in 1917. More recently a plant paper was founded, the policy of which has been to develop plant spirit and to interest employees in questions of health, safety, etc. Absenteeism has been markedly reduced by personal visits at the homes of workers as soon as their absence is reported. Through these visits the company has been able to assist the workers in time of illness or of other family troubles.

Although it has not seemed advisable for the company to conduct as elaborate a physical examination as is required in the army, its medical department has examined all new employees. Through these examinations a physical standard has been set which has tended to eliminate undesirable applicants for work. During the past year not a single case of venereal infection has been discovered in applicants.

This personnel work has brought about two satisfactory results from the standpoint of the American Pulley Company. Labor turnover records show a marked decrease, while production has improved without increasing the number of employees.—Charles H. Paull.

Organized Leisure as a Factor in Conservation. *Carol Aronovici.* Am. Journ. Sociol., Jan., 1919, 24, No. 4, 373-389.—An article which dwells on the social values of leisure for every person in a democracy. The discussion of leisure for purposes of recuperation, recreation, and conservation relates directly to the industrial worker.—Linda James.

Finding the Way to Satisfy the Creative Instinct in Workers.—American Gas Engineering Journal, Jan. 25, 1919, 110, No. 4, 70.—Gordon M. Fair.

INDUSTRIAL HEALTH LEGISLATION AND COURT DECISIONS: MALINGERING

Regulation of Women's Working Hours in the United States.—Am. Labor Legis. Rev., Dec., 1918, 8, No. 4, 339-354.—See WOMEN IN INDUSTRY.

WORKMEN'S COMPENSATION AND INSURANCE

Health Insurance. *Dorothy Ketcham.* Am. Pol. Sc. Rev., Feb., 1919, 13, No. 1, 89-93.—A brief review of the progress of health insurance in Europe and the various states of the United States. The favorable attitude of the American Federation of Labor as expressed at its annual meeting in St. Paul in 1918 is quoted at the close. The article is rich in reference to activities of health commissions and to legislative enactments. —Linda James.

Limitations of Occupational Disease Compensation. *J. B. Andrews.* Am. Labor Legis. Rev., Dec., 1918, 8, No. 4, 311-315.—"Three possible methods by which occupational diseases may nominally be brought under workmen's compensation laws." Their weakness. Health insurance as a solution of the difficulty.—Charles H. Paull.

Year's Developments Toward Health Insurance Legislation. *S. De Leon.* Am. Labor Legis. Rev., Dec., 1918, 8, No. 4, 316-318.—Statements of prominent persons in favor of health insurance.—Charles H. Paull.

SAFETY DEVICES

A Plan for Shop Safety, Sanitation and Health Organization. N. Y. State Dept. of Labor, Special Bull., No. 91, issued by the Industrial Commission, Jan., 1919.—This bulletin was written to supply the need of a definite plan for a safety organization which would lead to fewer accidents and to a more efficient working force. The plan was drawn up from the information gained through field investigation and through literature, and is thus based on the actual experience of many plants. This plan gives the workers a direct voice in the conduct of affairs leading to their welfare, and gains their coöperation by giving them a large part of the responsibility for successful accomplishment of the scheme.

The safety organization, as described, is composed of the following divisions: executives' committee, foremen's committee, workers' committee, and safety supervisor. The functions of each division are detailed. Methods of inspection, investigation and supervision are outlined, as well as methods of disseminating "safety" information among the committees and the workmen. Rules are suggested regarding meetings, amendments, and duties of foremen and workers, and suggestions are given concerning the guarding and planning of machinery, lighting, ventilation and sanitation.—Hazel Andrews.

REHABILITATION OF DISABLED EMPLOYEES

Some Problems of the Partially Disabled, in War and Industry. *Irene S. Chubb.* Am. Labor Legis. Rev., Dec., 1918, 8, No. 4, 294-305.—This article takes up, in order, the essential steps of a sound rehabilitation policy, together with certain dangers which present themselves in the working out of such a policy. The first step in rehabilitation is bedside therapy. The aim of this work is twofold: first, to develop the creative impulse; and secondly, to maintain the morale of the man during his recovery. This work may take a variety of forms of hand work, supplemented by careful guidance from specially trained directors. Bedside therapy should begin at the moment the individual is sufficiently strong to regain an interest in himself and his future, so that he will be allowed no moment of undirected thought which might lead to temporary and even ultimate discouragement. The experience of workers with cripples in the past who have become paupers through lack of proper initial attention, emphasizes the importance of this work.

When the cripple is sufficiently recovered he is ready to take definite training which will fit him for remunerative employment. Although we are particularly attracted at the present time by the war cripple, the industrial cripple is ultimately a more serious problem. It is estimated that 80,000 persons receive permanent disability annually in industry. The training which is offered to the war cripple should be made equally available to these people. Massachusetts, in 1918, was the first state in the Union to establish a division for the training and instruction of industrial cripples.

Vocational rehabilitation presents several problems which have not as yet been solved satisfactorily throughout the country.

(1) The cripple must, first of all, be assured that he will not be penalized by losing his compensation when he becomes remuneratively employed. He should not be penalized even though his employment may bring him greater returns than he received prior to his injury, because the fact of his injury may shorten his working life. A policy such as that defined by the compensation law in New Jersey is unsatisfactory because it places an arbitrary value on certain disabilities without taking into account the age at which the

worker is disabled, or the handicap which the disability presents in his particular occupation. The Industrial Accidents Commission of California bases its awards on three factors: (a) injury, (b) occupation, (c) age, thereby forming a more satisfactory basis for compensations. The federal law for vocational re-education attempts to solve the problem in a more general way by basing its ratings of compensation on the average loss of earning power for a certain disability, and permits a readjustment of these ratings from time to time.

(2) The cripple must be assured that he and his family will be cared for during the period of re-education. The federal government at the present time grants the family allowance and compensation to the war cripple during the time he is preparing to re-enter industry or take up other work. This scheme should be adopted in principle at least by the states and applied to industrial cripples. Scholarships could well be granted during re-education on condition that they be later repaid to the state, thus reducing the expense of upkeep to the state during training to a minimum.

(3) Opportunity for vocational guidance and employment should be available to all cripples. In selecting an occupation for re-education the cripple should be directed, under ordinary circumstances, to his old work or to a closely related occupation. The agency for re-education should establish a definite connection with public employment offices. The public employment agency is more satisfactory than one conducted by a training board because: (a) the public employment office will be more apt to place men under normal working conditions; (b) employers are more accustomed to using public employment offices; (c) there will be less danger of receiving calls from employers seeking only cheap labor; (d) public employment offices will be in touch with a wider field of employment.

(4) Compensation laws must be such that employers will not hesitate to hire cripples. Four schemes have been proposed for eliminating this difficulty: (a) A law (unjust to the worker) by which he waives all right to compensation; (b) a law by which the employer compensates the worker on the basis of the disability which would have resulted had not the worker been previously disabled; (c) a law by which the employer is liable for compensation for both injuries minus the compensation for the injury not received in his employ; (d) a law, adopted in New York and Ohio, which charges the employer for the disability received at his plant, while the state pays the difference between the whole disability and the last partial disability. This latter plan seems the most satisfactory of the four.

The great need of this country, at the present time, is a system of uniform state compensation laws which will encourage the industrial cripple to work rather than to become a burden to himself and to the community.—Charles H. Paull.

REHABILITATION AND VOCATIONAL TRAINING OF WAR CRIPPLES. *Constance Drexel.* Am. Labor Legis. Rev., Dec., 1918, 8, No. 4, 308-310.—Brief outline of the work of various agencies engaged in care of disabled soldiers.—Charles H. Paull.

PLACING SOLDIERS ON FARM COLONIES. *E. Mead.* Ann. Am. Acad. Pol. Sc., Jan., 1919, 81, Whole No. 170, 62-72.—An outline of a practical method of procedure in developing farm colonies for soldiers. Such a scheme would be of great value in assisting disabled soldiers to means of livelihood. —Charles H. Paull.

RECONSTRUCTIVE SURGERY. THE PROBLEM OF RECORDS. *J. A. Nutter.* Jour. Am. Med. Assn., Feb. 8, 1919, 72, No. 6, 410-411.—The descriptive terms applied to movements of joints have been varied and inexact. This fact has been particularly noticeable in Canada, where the board of pension commissioners has been overwhelmed with reports from physicians on joint disabilities. These depended almost entirely on words for accuracy and were extremely difficult to interpret and very unsatisfactory. The government was forced to print charts, showing the extremities with possible ranges of motion indicated in degrees. These, examining surgeons were required to fill and they have proved satisfactory in the case of the large joints but less successful in the case of the hands.

Experience has shown that the best type of record for hand disabilities is the Hart House Chart accompanied by a rapid free-hand diagram of the bones and joints. A sample Hart House Chart is as follows:

Hart House Chart

	Movement	
Middle Finger (Left)	Active	Passive
Prox. flex	20°	35°
Ext.	Lacks 5° of full	Full
Med. flex	40°	45°
Ext.	Lacks 20° of full	Full
Dist. flex	20°	45°
Ext.	Lacks 30° of full	Full

—Cecil K. Drinker.

ABSTRACT *of the* LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME I JUNE, 1919 NUMBER 2

GENERAL

THE UNIVERSITY OF PUBLIC HEALTH. *G. E. Vincent.* Science, March 14, 1919, N. S. 44, No. 1263, 245-251.—Abstract of an address delivered at the anniversary exercises of Johns Hopkins University, Feb. 27, 1919, by George E. Vincent, president of the Rockefeller Foundation. The author states that the new plans of the Harvard Medical School for research in occupational diseases, for demonstration in industrial hygiene in connection with factories and stores, for the training of a special personnel, and for the publication of a journal, are significant of the University attitude towards the problems of public health. —G. Fair.

DEMOCRACY AND PUBLIC HEALTH ADMINISTRATION. *C. J. Hastings.* Am. Jour. Pub. Health. March, 1919, 9, No. 3, 172-179.—In his address the president of the American Public Health Association (Dec. 9, 1918), discusses the various phases of public health administration, and makes reference also to industrial hygiene which, in his opinion, should be considered as part and parcel of community hygiene.—G. Fair.

HEALTH OF OHIO COAL MINERS. *E. R. Hayhurst.* Ohio Pub. Health Jour., Feb., 1919, 10, No. 2, 63-69.—This is a report of an investigation made by the author in co-operation with the State Department of Health to get more knowledge of the status of health, of vital statistics, and of public health administration in coal mining districts, and to find what provisions exist for meeting hazards of sickness and death. The extent and nature of the industry in Ohio are given, with descriptions of the districts visited. Drift mines, room-and-pillar and shaft mines are the important kinds. Black powder is the chief blasting substance used. The chief mine gases are fire damp (methane), black damp (deficiency of oxygen) and white damp (carbon monoxide). The state laws provide for good ventilation and the miners do not suffer much from the ill effects of mine gases. The temperature is nearly constant and the humidity high. Dust constitutes the chief danger to health. The eight-hour day is universal, and over-time infrequent.

Absenteeism averages about ten persons per day. Labor turnover is more pronounced in large mines. Ninety per cent. of the employees are foreigners, largely from the southern and eastern parts of Europe. The majority (87 per cent.) are between 22 and 59 years of age. The influenza epidemic was very severe, causing many mines to shut down completely. The inspection system is concerned with prevention of accidents, explosions, fires and asphyxiations and although it is short of man power, it is of great benefit to the general health. Wages were good at the time of inspection.—Hazel Andrews.

SHIPPING BOARD PROTECTS HEALTH OF SHIPYARD MEN.—Eng. N.-Rec., Feb. 27, 1919, 82, No. 9, 422.—A brief summary of the work of the United States Shipping Board.—G. Fair.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES DURING 1917. *A. H. Fay.* U. S. Bur. of Mines, Tech. Paper 192.—A twenty-page pamphlet relating to the amount and distribution of the manufacture of explosives in the United States, to the various amounts employed in different uses up to 1917, and to the amounts exported. —C. K. Reiman.

TREATMENT OF INDUSTRIAL PROBLEMS BY CONSTRUCTIVE METHODS. U. S. Dept. Labor, Working Conditions Service, Washington, 1919.—This paper is a brief outline of the activities and proposed developments in the Working Conditions Service. In this service three divisions have been established.

1. Division of Industrial Hygiene and Medicine.
2. Division of Safety Engineering.
3. Division of Labor Administration.

In addition a Research Branch of the service has been constituted in order to correlate the activities of these divisions, and to extend their efficiency. Employers may communicate with the Director General of the service, Mr. Grant Hamilton, if they wish to make use of the activities of any of the above-mentioned divisions.—C. K. Drinker.

HOSPITAL SERVICE IN RURAL COMMUNITIES. *E. C. Meyer.* Jour. Am. Med. Assn., April 19,

1919, 72, No. 16, 1135-1136.—This article and those continuing it are of indirect but great industrial interest, since so often in small communities the plant hospital must serve not only the employees but the entire neighboring country side.

With the demonstration that both old and young suffer less from sickness, and that life is longer in the cities, the rural health problem and with it the rural hospital problem have come strongly into the foreground.

The position of the rural hospital has been a hard one. Adequate treatment of the sick is circumscribed by difficulty in getting proper buildings, efficient staffs of physicians, and well-trained nurses. Educational work, on clinical lines, is seriously limited by scarcity of clinical material. Research is largely out of the question, and social work has been prevented by lack of vision in some cases and lack of assistance in others. These recognized functions of the city hospital have thus fallen more and more in the background, whereas the idea that the rural hospital should be above all else an educational institution through which the community may be taught the fundamentals of hygiene and right living has steadily been given prominence. Coupled with this has come the suggestion that the rural hospital may be made a useful mechanism in surveying community conditions and needs in matters of health and sanitation. There seems to be little doubt that if the rural hospital achieves these latter purposes of prevention successfully, it will have accomplished more effective work for the community than can now be represented on the basis of treatment alone.

Many questions arise as a result of these considerations. Is it necessary to maintain rural hospitals so precisely on the expensive city pattern? Is it not possible that in the development of rural hospitals on their present basis we are making the same expensive mistake as has been made in the extreme expenditures for isolated tuberculosis hospitals, which are an admitted failure in reducing the disease incident throughout the country? With the easy transportation of to-day should we not specialize more completely upon the side of prevention in our rural hospitals, making minimum provisions for treatment and sending bad cases for expert care to nearby cities?

Some of the reasons why it is worth while to develop this new idea in regard to rural health become apparent on considering the following data. (*Continued*).—C. K. Drinker.

Hospital Service in Rural Communities. *E. C. Meyer.* Jour. Am. Med. Assn., April 26, 1919, 72, No. 17, 1219-1223.—The U. S. Census of 1890 brought out the fact that sickness is more prevalent in the country than in cities. More recent material accumulated by the Metropolitan Life Insurance Co., the State Charities Aid Association of New York in Dutchess County, N. Y., the Department of Health of New York City, and the Community Health Station in Framingham, Mass., brings out the fact that the sickness rate of this country varies from 20 to 25 per thousand, and the disability rate from 16 to 20 per thousand. When minor and trivial illnesses of all sorts are included, and particularly ailments which should have medical or dental advice or treatment, the number of cases of sickness discovered is greatly increased. The rate in such cases has been found to run at from 40 to 70 and more, per thousand, according to the thoroughness of the survey.

Charts and tables are now presented showing how the rural death rate has remained fairly constant, while the urban death rate has declined until a considerably lower point is reached. Unfortunately, no adequate figures exist on rural morbidity.

Finally figures are given upon the economic loss due to sickness. The average duration of sickness among the general population (which includes wage earners) appears to be from six to twelve days a year. Charitable agencies uniformly find sickness to be one of the chief factors creating dependency (*Continued*).—C. K. Drinker.

SYSTEMIC OCCUPATIONAL DISEASE: OCCURRENCE, TREATMENT AND PREVENTION

CIRCULATION

Two New Diagnostic Methods for Patients with Cardiac Disease. *J. E. Benjamin* and *E. R. Brooks*, Jour. Am. Med. Assn., March 8, 1919, 72, No. 10, 707-709.—The object in the first instance is to separate true tachycardias of persistent type from tachycardia due to excitement —to the circumstances of the examination. The individual on direction drops the head and bends forward to about an angle of 45 degrees, whereupon the rapid heart will retard to a remarkable degree very quickly, sometimes to half of the original rate if the case is one of simple tachycardia due to excitement. True persistent tachycardia is not affected at all.

The intensification of abnormal presystolic sounds through inhalation of amyl nitrite as first recommended by Morison has been found valuable. In ten instances out of forty-eight suspected cases of mitral stenosis positive diagnosis has been made by listening to the presystolic sounds during amyl nitrite inhalation.—C. K. Drinker.

Observations Upon Fainting Attacks Due to Inhibitory Cardiac Impulses. *T. F. Cotton* and *T. Lewis.* Heart, April, 1918, 7, No. 1, 23-34. —The authors found fainting attacks occurring frequently from very slight stimuli in soldiers who suffered from irritable heart. As a rule the so-called premonitory symptoms are a definite part of the attack. The authors were fortunate enough to observe several such attacks and found that the anemia of the brain was due to a reduction in pulse rate as well as in the blood pressure. The fall is rather slow and the recovery

is even slower. The association of lowered rate with the fall in pressure points decisively to a disturbance of the inhibitory mechanism. The final proof that these attacks are of vagal origin is furnished by the fact that they are relieved by atropin.—C. C. Lund.

THE EFFECT OF CERTAIN SENSORY STIMULATIONS ON RESPIRATORY AND HEART RATE IN CASES OF SO-CALLED "IRRITABLE HEART." *J. C. Meakins* and *R. M. Wilson.* Heart, April, 1918, 7, No. 1, 17-22.—The authors noticed that cases of "irritable heart" showed a marked increase in pulse and respiratory rate from emotional stimuli as well as on exertion. A quantitative method of testing this when the patients were surprised, either by a pistol shot or flash of light, was worked out. In all cases the response of the patients was greater than of the controls. The authors found that the response of the pulse rate was more constant and to a greater degree in the various cases than the change in the respiratory rate. The increased pulse varied from 3 to 45 beats per minute after the flame and from 2 to 22 beats per minute after the pistol shot.

On going over the records of the individuals, it was found that, with two exceptions, those patients with the greatest incapacity for work showed the most marked increase in pulse rate on sensory stimulation. The authors say that their best results were with the flame test, but it has occurred to the reviewer that a louder noise than the pistol used might have given the same results as the flame tests.—C. C. Lund.

ORTHODIAGRAPHIC OBSERVATIONS ON THE SIZE OF THE HEART IN CASES OF SO-CALLED "IRRITABLE HEART." *J. C. Meakins* and *E. B. Gunson.* Heart, April, 1918, 7, No. 1, 1-16.—The authors worked with a large number of soldiers in the Military Heart Hospital at Hampstead. They found a slight decrease (0.7 cm.) in the average size of "irritable" hearts, compared with normal. The "irritable" cases with diffuse apical impulse were found to be the same in this regard as those that did not have this sign. The authors also found that rest in bed results in an average increase of 0.7 cm. in the size of the transverse diameter of the heart in these cases. After strenuous Swedish exercises the patients that did not have symptons showed a decrease of 1.10 cm. in the size of their hearts, while patients that showed symptoms did not show any decrease.—C. C. Lund.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

DINITROBENZOL POISONING. Office internat. d'hyg. pub., Oct., 1918, 10, No. 10. Abstract of article by *O. Steiner* in Cor.-Bl. f. schweiz. Aerzte, Aug., 1918, p. 1139.—The author observed seven serious cases of dinitrobenzol poisoning in a brief interval of time. He finds that exposure to these vapors produces a bluish coloration of the mucous membranes accompanied by headache, general malaise, etc. These symptoms as a rule disappear two or three days after stopping work. Tolerance may be established, repeated exposures in these cases only producing the blue color in the mucous membranes. Dinitrobenzol is a poison by virtue of its action on the blood and central nervous system. It reaches the body less by means of the lungs than directly through the skin, from the wearing of clothes saturated with it. Workmen should be instructed as to the toxicity of this substance and vigorous measures should be taken in the industries to eliminate direct contact with dinitrobenzol.—L. Greenburg.

METHANE ACCUMULATIONS FROM INTERRUPTED VENTILATION. *H. I. Smith.* and *R. J. Hamon.* U. S. Bur. of Mines, Tech. Paper 150.—A forty-six page pamphlet of results of tests and experiments obtained from some Illinois and Indiana coal mines. Discussions are included of causes of sudden methane liberation. A list of papers published by Bureau of Mines on coal mining is appended.—C. K. Reiman.

STUDIES IN A CASE OF ACUTE BICHLORIDE OF MERCURY POISONING TREATED BY THE NEWER METHODS, AND FOLLOWED BY RECOVERY. *J. Rosenbloom.* Am. Jour. Med. Sc., March, 1919, 157, No. 3, 348-356.—Full details for treatment are given and emphasis placed on the importance of combatting the acidosis.—G. R. Minot.

PICRIC JAUNDICE AND ICTERUS. *F. Malmejac* and *C. Lioust*, Jour. de physiol. et de path. gén., April, 1918, 17, No. 4, 685-691.—After a study of 1029 cases of true jaundice or of picric intoxication, the following conclusions are drawn: (1) Examination for picric and picramic acids in the urine, the blood, the cerebro-spinal fluid, and the skin can be made, in the present state of knowledge, with an exactness which may be regarded as absolutely reliable. (2) The presence of biliary pigments does not in any way disturb this examination. (3) The ingestion of picric acid in doses of 30, 60 or even 90 centigrams, causes, usually, a disturbance which is not grave, which has its own peculiarities, and which would not in any case be confused with true jaundice. The authors describe the methods which they employed.—W. B. Cannon.

THE MECHANISM OF THE PROTECTIVE ACTION OF CARBOHYDRATE DIET IN PHOSPHORUS AND CHLOROFORM POISONING. *J. P. Simonds.* Arch. Int. Med., Mar. 15, 1919, 23, No. 3, 362-379.—Simonds thinks the facts he presents are sufficiently well substantiated to justify the opinion that the administration of sugar will prove to be an important therapeutic measure in phosphorus and chloroform poisoning in human beings, and also perhaps in acute yellow atrophy of the liver, and probably in eclampsia.—G. R. Minot.

DUST HAZARDS AND THEIR EFFECTS

A SIMPLE INEXPENSIVE RESPIRATOR FOR DUST PROTECTION. N. Y. State Dept. of Labor, Special Bull., No. 90, issued by the Industrial Commission, Dec., 1918.—C. H. Paull.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

ANTHRAX IN A SOLDIER. *W. H. Norton* and *E. F. Kohman*. Jour. Am. Med. Assn., April 19, 1919, 72, No. 16, 1129-1131.—Report of a fatal case of anthrax in which the bacilli were isolated from a shaving brush of badger's hair or imitation badger's hair.—C. K. Drinker.

REPORT OF THE BUREAU OF COMMUNICABLE DISEASES FOR SEPTEMBER, 1918. Division of Parasitology. Cal. State Bd. of Health, Month. Bull., Nov.-Dec., 1918, 14, No. 5-6, 174.—This article reports fifty-three examinations for hookworm made during September, on miners from the copper mines of Shasta County. Two positive cases were found. A great improvement was noted in toilet conditions of the mines in Amador County.—Hazel Andrews.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

OCCUPATIONAL AFFECTIONS OF THE SKIN. *S. D. Hubbard*. N. Y. City Dept. of Health, Month. Bull., Feb., 1919, 9, No. 2, 41-44.—The various occupational affections of the skin are classified according to causes. Those produced by friction, temperature, irritants and infections are mentioned and the means of prevention discussed. A table of the common occupational skin irritants is appended, which shows the irritant, the trade affected, the effect of the irritant and methods of prevention.—Hazel Andrews.

INVESTIGATION INTO DERMATIC EFFECT AND INFECTIVE CHARACTER OF A LUBRICATING COMPOUND. *F. E. Deeds*. U. S. Dept. Labor, Working Conditions Service, Washington, 1919.—The following *Conclusions and Recommendations* which end this article sum up its contents:

1. The chemical composition of the grease may have an irritant action upon the skin of the workers exposed to it. Particularly the unsaturated hydrocarbons in the higher distillates exert a dehydrating action upon the skin and tend to dissolve out the natural fats and oils, leading to a dryness of the skin, with possible subsequent cracking, and possibility of instigation of incipient dermatitis.
2. The grease as it comes to the plant is apparently uncontaminated, but may become contaminated immediately upon being handled by an employee having a pus infection present upon his hands or arms.
3. From bacteriological examination it appears that the grease may well act as a carrier of bacteria, exerting no bactericidal action; hence any contaminating organisms may be carried from one operative to another.
4. From the bacteriological examination, since *Staphylococcus pyogenes aureus* was found in cultures taken from the employees' hands, it is evident that the grease may be contaminated with pus-producing organisms directly from normal hands, merely requiring a cut or an abrasion or lowered personal resistance, for the bacteria to cause an industrial acne, eczema, or furunculosis.
5. Since the grease is not germicidal, the interchange of "waste" and wiping rags should be advised against, since an infection may be carried in this way.
6. The employees should be provided with gloves, preferably of some impervious or semi-pervious material such as leather, thus lessening the amount of grease reaching the skin of the hands. These should be cleaned frequently.
7. The employees should wash their hands more often with warm water and a good soap. Although it is argued that the hands at once become dirty again, nevertheless this practice lessens the chance of infection. Washing facilities should be provided.
8. In order to counteract the drying action of the oils, there should be provided for the men some sort of ointment, such as lanolin, to be used after the hands are washed.
9. Instruction in personal hygiene should be given the men by the plant physician, and they should be advised especially against anything but medical care for wounds and skin eruptions. Prompt care for the skin eruptions should be given. Overseers and foremen should be required to report to the plant physician all employees having skin eruptions of any kind whatsoever.
10. Clean working clothes should be provided for the men at least once a week.
11. Men who are subject to chapped skin and men who are susceptible to skin irritation, acne, furunculosis, etc., should be transferred, if possible, to some work involving less exposure to a possible infection hazard.
12. The chemical disinfectant used should be such that it can exert its action in the presence of organic matter and can be used in sufficiently low concentration so that the odor is not nauseous to the workers nor the compound deleterious to the skin.
13. Owing to the fact that the bacteriological work in this investigation was done several months after the epidemic of furunculosis had existed, the value of bacteriological results is somewhat vitiated. It is suggested that should a similar epidemic arise in the future there be bacteriological analyses run immediately, cultures being made from the grease, and also from the infected area upon the workmen.
14. A system of morbidity recording should be established.
15. Promiscuous spitting should be abolished, since there is a likelihood of the material handled becoming contaminated in this way.
16. Washing or cleansing of the hands in a common supply of paraffin oil or of petrolatum is advised against, since such practice may lead to a contamination of these constituents of the mixture. Each worker may have his own individual supply, which might be kept in a small bottle for his own use. It is only necessary to pour a few drops on the palm of the hand for cleaning purposes.—C. K. Drinker.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

RUPTURE OF CAST IRON IN CONTACT WITH MIXED ACID. *A. C. Cummings*. Jour. Soc. Chem. Indust., Feb. 15, 1919, 38, No. 3, 31-32.—Serious accidents have resulted from the rupture of cast iron apparatus in contact with nitric acid or fuming sulphuric acid. The rupture is attributed to the expansion caused by the growth of crystals of iron salts within the metal.—C. H. Fiske.

THE SAFETY MOVEMENT IN THE IRON AND STEEL INDUSTRY, 1907-1917. U. S. Bur. Labor Statis., Bull. 234, June, 1918.—A pamphlet of 299 pages containing: Part I.—A review of the safety movement, with special reference to the war; Part II.—Causes and prevention of accidents; charts and illustrations. For brief review of this bulletin see U. S. Bur. Labor Statis., Month. Labor Rev., Dec., 1918, 7, No. 6, 316-317.—Katherine R. Drinker.

INDUSTRIAL ACCIDENTS IN THE UNITED STATES IRON AND STEEL INDUSTRIES. Engin., Feb. 7, 1919, 107, No. 2771, 164-167.—A discussion of Bulletin No. 234, U. S. Bureau of Labor Statistics, from the British point of view.—G. Fair.

A PLAN FOR SHOP SAFETY, SANITATION AND HEALTH ORGANIZATION. N. Y. State Dept. of Labor, Special Bull. No. 91, Jan., 1919.—This bulletin was written to supply the need of a definite plan for a safety organization, which would lead to fewer accidents and to a more efficient working force. The plan was drawn up from the information gained through field investigation and literature and is thus based on the actual experience of many plants. This plan gives the workers a direct voice in the conduct of affairs leading to their welfare, and gains their co-operation by giving them a large part of the responsibility for success.

The safety organization, as described, is composed of the following divisions: executives' committee, foremen's committee, workers' committee, and safety supervisor. The functions of each division are detailed. Methods of inspection, investigation and supervision are outlined, as well as methods of disseminating "safety" information among the committees and the workmen. Rules are suggested regarding meetings, amendments, and duties of foremen and workers, and suggestions are given concerning the guarding and planning of machinery, lighting, ventilation and sanitation.—Hazel Andrews.

"ENGINEERING REVISION" AS SEEN BY SAFETY COMMITTEES. *L. W. Chaney.* Month. Labor Rev., Dec.,1918, 7, No. 6, 1-17.—Engineering Revision is defined as a term covering "all applications of engineering skill which bear upon industrial safety." The discussion is based upon the experience of a large steel company in accident study for the three years ending with 1917. Their 1642 disabling accidents are classified under three heads: (1) Preventable by engineering revision; (2) Preventable by care of worker; (3) Unavoidable trade risk. A study of the data tends to confirm the contention that the "prevention of minor injuries lies largely in the education of the men to correct and safe methods of work," while a majority of preventable major injuries can be eliminated by engineering revision. The discussion concludes with short descriptions of 207 cases of death and major mutilation classified under the three heads previously named.—C. H. Paull.

THE BRITISH INDUSTRIAL "SAFETY FIRST" ASSOCIATION. Engineer, Mar. 14, 1919, 127, No. 3298, 263.—Editorial comment on the aims of this recently established association.—G. M. Fair.

"ARMOR" FOR SAFETY. Factory, Feb., 1919, 22, No. 2, 252-253.—A group of pictures of safety devices used to advantage in different industries.—C. H. Paull.

STARTING NEW MEN RIGHT. Factory, Feb., 1919, 22, No. 2, 242-243.—A brief statement of the procedure in different plants in presenting the "Safety First" idea to new employees. Emphasis is placed upon the fact that new men without adequate instruction are the most serious accident risks.—C. H. Paull.

"REDUCING ACCIDENT RISKS" SECTION. Factory, Feb., 1919, 22, No. 2, 396-406.—Short comments upon "Making Bulletins Interesting"; various sorts of poisoning and their prevention; "Selling Safety to the Big Boss"; "Who Shall Make Safeguards," etc.—C. H. Paull.

HEAD AND EYE PROTECTION. *W. Newell.* Bull. N. Y. State Indust. Commission, Feb., 1919, 4, No. 5, 86.—The writer of this paper, which was presented before the Third Industrial Safety Congress of New York State, calls attention to the seriousness of the problem of head and eye protection. Statistics for a total of one-third of all the fatal accidents occurring annually in the United States show that about 8.3 per cent. are eye accidents; or of the 2,000,000 non-fatal accidents, approximately 200,000 are eye accidents. It is estimated that 15,000 persons in the United States are at the present time blind as a result of industrial accidents. The financial cost alone for maintaining these workers is placed at about $10,000,000, and this figure does not include such factors as the loss of productiveness to the community.

The use of goggles is the most effective means for preventing most eye injuries. A list of occupations in which goggles of various sorts should be used is given. Upon the basis of the character of protection afforded, goggles are divided into four groups: (1) goggles for protection against flying material; (2) goggles for protecting the eyes from injurious light or heat; (3) goggles for protecting the eyes against gases, fumes and liquids; (4) goggles to protect the eyes against dust and wind. Each type of goggles is discussed briefly, emphasis being placed upon the fact that the goggles must be made comfortable to the worker, and that systematic care should be taken of them to repair damaged lenses, and to see that at all times they are fitted to the eyes of the individual using them. Both in fitting goggles and in removing foreign bodies from the eyes no one but a physician should be employed.—C. H. Paull.

ADDITIONAL SAFEGUARDS REQUIRED FOR WOMEN EMPLOYEES. *P. F. O'Shea.* Ind. Management, April, 1919, 57, No. 4, 301-302.—A brief account of some devices for protecting women's skirts from machinery.—C. H. Paull.

INDUSTRIAL SURGERY

Early Suturing of Wounds of the Face. *V. H. Kazanjian.* Jour. Am. Med. Assn., March 1, 1919, 72, No. 9, 626-630.—Experience in base hospitals has shown that primary suturing of facial wounds, unless the injury has been mild and superficial, results poorly. Superficial wounds with no loss of soft tissue and also those with slight or no connection with the oral and nasal cavities may in most instances be closed successfully when first seen. Secondary suturing should be done early, fifth to twelfth day after injury, depending upon the nature of the wound and the condition of the patient. Fixation of the bony fragments and a control of sepsis always precede the operation.—C. K. Drinker.

Impairment of Function of the Hand Due to War Injuries. *C. R. Metcalf.* Jour. Orthop. Surg., April, 1919, 1, No. 4, 198-214.—A very much condensed and very didactic article on the treatment of all kinds of traumatic lesions of the hand. If the author is reflecting in his article, the experience of most of the men in the A. E. F., the treatment of injuries of the hand will shortly become a very exact science.—W. Herman.

Splint Devised for Treatment of Stiff Metacarpo-Phalangeal Joints. *F. E. Lewis.* Jour. Orthop. Surg., April, 1919, 1, No. 4, 222-225.—A description of a new splint that has been very successful in the hands of the author in these troublesome cases.—W. Herman.

Wounds of the Fingers and Toes. *P. Descomps* and *R. Ducartaing.* Paris Méd., Jan. 18, 1919, 9th year, No. 3, 50-53.—A brief article advocating immediate disinfection, closure and thorough immobilization of wounds of the fingers and toes. The authors believe that if these measures are carried out thoroughly there is rapid and regular restoration of function, but that imperfect closure or imperfect immobilization and disinfection will give decidedly poor results.—Katherine R. Drinker.

Collected Work upon Surgical Reconstruction. Zeitschr. f. orthop. Chir., 1917, 37, 1-833. One full volume.—This volume is a beautifully illustrated and very extensive collection of papers on the orthopedic reconstruction of the German wounded. Practically every phase of such work is covered, and the 750 illustrations present not only mechanical details of a great variety of artificial limbs and appliances, but also appropriate methods for training in their use.—C. K. Drinker.

On the Prevention and Treatment of Static Flat-Foot Through Regulation of Function together with Observations on the Statics and Mechanics of the Normal Foot and Flat-Foot. *K. T. Petersen.* Zeitschr. f. orthop. Chir., March, 1918, 38, No. 1-2, 277-297.—A highly technical article, giving orthopedic measures for the prevention and treatment of flat-foot.—C. K. Drinker.

Results Obtained by Treating Weak Feet Along Military Lines Among Civilians. *L. C. Donnelly.* Jour. Orthop. Surg., April, 1919, 1, No. 4, 219-221.—A short summary of the excellent results obtained among a large number of young men by a very simple method, *viz.:* the fitting them out with proper Munson last shoes, and having them do some very simple exercises.—W. Herman.

Dichloramin-T and Petrolatum Dressing for Burns. *T. Sollmann.* Jour. Am. Med. Assn., April 5, 1919, 72, No. 14, 992-993.—An ointment of three parts of surgical paraffin and seven parts of liquid petrolatum has relatively little destructive action on dichloramin-T and can be used as a protective dressing on wounds (burns) treated with dichloramin-T-chlorcosane solution, and even as a basis for a dichloramin-T ointment.

Ordinary petrolatum, irrespective of its color, is very destructive of dichloramin-T and cannot be used effectively in connection with it. (By "destructive" is meant ability to liberate available chlorin during a given period of time.)

Liquid petrolatum can be used in emergencies as a vehicle for dichloramin-T, although it is inferior to chlorcosane. Solutions of dichloramin-T in carbon tetrachlorid are very stable, while those in kerosene or in olive oil lose chlorine rapidly and so deteriorate.—C. K. Drinker.

FATIGUE AND OCCUPATIONAL NEUROSES

The Effect of Fatigue on the Heart and Cardio-Skeletal Quotient. *W. L. Mendenhall.* Am. Jour. Physiol., Feb., 1919, 18, No. 1, 13-21.—It is shown, by measurements of the threshold stimulus for the ventricle, that cardiac irritability is generally increased as a result of enforced muscular activity. When fatigue of the most profound character is induced the excitability of the ventricle may be depressed. The results are presumably due to fatigue substances in the circulation. The experiments have been made upon frogs and need to be confirmed for the mammal. —P. G. Stiles.

Creatinin and Creatin. *M. Wahl.* Arch. de méd. expér. et d'anat. path., September, 1918, 28, No. 2, 105-154.—The conclusion is drawn that fatigue may be the occasion for greatly increased elimination of creatinin, but since the observations were made on severely wounded men the injured tissue may have been the occasion for the observed increase.—W. B. Cannon.

NUTRITION

Researches in Experimental Scorbutus. *E. Weill* and *G. Mouriquand*. Jour. de physiol. et de path. gén., July, 1918, 17, No. 5, 849-855.—The authors criticize experiments by Holst and Frölich on experimental production of scorbutus in guinea pigs on the basis of using unnatural food. The present experiments were performed on rabbits and cats to study the deficiencies in habitual nourishment which may be produced by heat and preservation. Boiled or sterilized food produced in the rabbit a typical scorbutic syndrome; and freshly sterilized meat, as well as meat sterilized and preserved for many months, caused in the cat a nervous syndrome similar to that observed in pigeons on a diet of rice or other cereals decorticated or sterilized. They found that guinea pigs fed dry grain (barley and oats), died without signs of scorbutus, but those fed germinated grains died with marked scorbutic manifestations, though they lived much longer than those given dry grains. The authors suggest that germination prepares the nutriment for more ready digestion and assimilation, but does not give rise to an antiscorbutic, since the animals suffer from the disease. In the further growth of the cereal an antiscorbutic substance may be developed.—W. B. Cannon.

Is Undernourishment of Schoolchildren Determinable? *C. F. Th. von Ziegenweidt*. Nederlandsch Tijdschr. v. Geneesk., Feb. 8, 1919, 63, First Half, No. 6, 454-457.—Comparisen of curves of nourishment constants, plotted in the years 1914, 1917 and 1918, with a view to finding out the influence of war diet as reflected in these curves.—N. C. Foot.

Some Remarks on the Comparison of the State of Nourishment in Schoolchildren. *C J. van der Loo*. Nederlandsch Tijdschr. v. Geneesk., Feb. 8, 1919, 63, First Half, No. 6, 447-454.—A discussion of the methods of obtaining a constant in plotting nourishment curves, with a new formula based on statistics and comparison and criticism of other, older formulae.—N. C. Foot.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Electric Welding and Welding Appliances. Engineer, Feb. 14, 1919, 127, No. 3294, 145-146.—This discussion relates to the use of electric welding appliances in the industries, and among other things, discusses the importance of the protection of the worker during the welding operation.—G. Fair.

WOMEN IN INDUSTRY

Federal Standards for the Employment of Women in Industry. U. S. Bur. Labor Statis., Month. Labor Rev., Jan., 1919, 8, No. 1, 216-230.—The Woman in Industry Service of the Department of Labor has prepared a statement of the standards to govern the employment of women in industry which have been adopted by the War Labor Policies Board. The more important of these standards bear upon the subjects of *Hours of Labor*, *Wages* and *Working Conditions*. No woman shall be permitted to work more than eight hours in one day or forty-eight hours in one week, and shall not be employed between the hours of 10 P. M. and 6 A. M. Each female worker shall have one day of rest in every seven days. Wages shall be established on the basis of occupation and not of sex; women doing the same work as men shall receive the same wages as men. The working conditions in factories shall be governed by the laws and codes of the state in which the work is performed, proper attention being given to ventilation, lighting, safety, etc. No work is to be given out to be done in rooms used for living or sleeping purposes.—L. Greenburg.

Proposed Employment of Women During the War in the Industries of Niagara Falls, N. Y. U. S. Bur. Labor Statis., Month. Labor Rev., Jan., 1919, 8, No. 1, 231-246.—The Women in Industry Service of the U. S. Department of Labor has issued a report on the employment of women during the war in the industries of Niagara Falls, N. Y.

The four main industries studied were: Abrasive manufacture, chemicals and gases, electrodes and carbon, metals and alloys; in all, twenty-one plants, employing over 9000 persons, being investigated. The chief health hazards disclosed were those due to dusts, fumes and gases, excessive heat and noise, the lifting and carrying of heavy weights, and the lack of adequate ventilation and illumination.

The final recommendations of the report emphasize the importance of the application of dust removal systems and safety appliances in the plants. Health supervision, especially in cooperation with the U. S. Public Health Service, and lastly the great importance of extending the scope of the workmen's compensation law so as to include occupational diseases.—L. Greenburg.

Weekly Earnings of Women in Five Industries. N. Y. State Dept. of Labor, Special Bull., No. 92, Feb., 1919.—The five industries investigated were paper boxes, shirts and collars, con-

fectionery, cigars and tobacco, and mercantile establishments. The report shows a very considerable rise in women's wages during the past five years. Detailed statistics are given for the various industries.—Hazel Andrews.

WOMEN IN INDUSTRY. Month. Labor Rev., December, 1918, 7, No. 6, 312-315.—A summary of English experience with women munition workers. —C. H. Paull.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

BUILDING A HOME FOR AN INDUSTRY. Am. Arch., March 26, 1919, 115, No. 2257, 467-475.—The construction of the dye works of E. C. Klipstein & Sons Co., at South Charleston, W. Va., is described.—G. M. Fair.

INDUSTRIAL SANITARY EQUIPMENT STANDARDS, PART II. Editorial. Metal Worker, etc., Feb. 21, 1919, 91. No. 8, 238-240.—A description of the standards and specifications adopted by the Standard Oil Company for the warm water supply of showers and wash stands and for the supply of cool drinking water to the workers.—G. Fair.

CODE OF LIGHTING FOR FACTORIES, MILLS, AND OTHER WORK PLACES. U. S. P. Health Rep., Jan. 24, 34, No. 4, 103-123.—The divisional committee on lighting, section of sanitation, committee on welfare work of the committee on labor, advisory commission, Council of National Defense, has recommended for adoption in all the states a factory lighting code.

The committee's report cites these advantages of good lighting:

1. Reduction of accidents.
2. Greater accuracy in workmanship.
3. Decreased spoilage of product.
4. Increased production for the same labor cost.
5. Less eye strain.
6. Better working and living conditions.
7. Greater contentment of the workmen.
8. Better order, cleanliness and neatness in the plant.
9. Easier supervision of the men.

The report gives an analysis of lighting, natural and artificial, and offers the following rules, which constitute the basis of the Pennsylvania and New Jersey factory lighting codes:

Rule 1: General requirement.—Working or traversed spaces in buildings or grounds shall be supplied during the time of use with artificial light in accordance with the following rules when natural light is less than the intensities specified in Rule 2.

Rule 2: Intensity required.—The desirable illumination to be provided and the minimum to be maintained are given in the following table:

	Foot-candles at the Work: Ordinary Practice	Minimum
(a) Roadways and yard thoroughfares	0.05- 0.25	0.02
(b) Storage spaces	.50- 1.00	.25
(c) Stairways, passageways, aisles	.75- 2.00	.25
(d) Rough manufacturing, such as rough machining, rough assembling, rough bench work	2.00- 4.00	1.25
(e) Rough manufacturing, involving closer discrimination of detail	3.00- 6.00	2.00
(f) Fine manufacturing, such as fine lathe work, pattern and tool making, light-colored textiles	4.00- 8.00	3.00
(g) Special cases of fine work, such as watch making, engraving, drafting, dark-colored textiles	10.00-15.00	5.00
(h) Other work, such as accounting, typewriting, etc.	4.00- 8.00	3.00

Rule 3: Shading of lamps.—Lamps shall be suitably shaded to minimize glare.

Note: Glare, either from lamps or from unduly bright reflecting surfaces, produces eye strain and increases accident hazard.

Rule 4: Distribution of light on work.—Lamps shall be so installed in regard to height, spacing, reflectors, or other accessories, as to secure a good distribution of light on the work, avoiding objectionable shadows and sharp contrasts of intensity.

Rule 5: Emergency lighting.—Emergency lamps shall be provided in all work-space aisles, stairways, passageways and exits, to provide for reliable operation when, through accident or other cause, the regular lighting is extinguished. Such lamps shall be in operation concurrently with the regular lighting and independent thereof.

Rule 6: Switching and controlling apparatus.—Switching or controlling apparatus shall be so placed that at least pilot or night lights may be turned on at the main point of entrance.

Under the heading of *daylight* the committee considered natural illumination for sufficiency, continuity and diffusion, and set the following requirements:

1. The light should be adequate for each employee.
2. The windows should be so spaced and located that daylight conditions are fairly uniform over the working area.
3. The intensities of daylight should be such that artificial light will be required only during those portions of the day when it would naturally be considered necessary.
4. The windows should provide a quality of daylight which will avoid a glare due to the sun's rays and light from the sky shining directly into the eye, or where this does not prove to be the case at all parts of the day, window shades or other means should be available to make this end possible.
5. Ceilings and upper portions of the walls should be maintained a light color to increase the effectiveness of the lighting facilities from window areas. The lower portion of walls should be somewhat darker in tone to render the lighting restful for the eye. Factory green or other medium colors may be used to good effect.

Natural lighting is classified into:

(a) That case in which windows are located on the sides of the building or in the framework of saw-tooth construction, where diffused light from the sky reaches the work during a large portion of the day.

(b) That case in which windows are located overhead on a horizontal or nearly horizontal plane in the form of skylights, thus furnishing direct light from the sky during a large portion of the day.

(c) That case in which prismatic glass takes up the direct light in the sky and re-directs it into the working space.

More in detail, the committee's report goes into a rather exhaustive review of methods of illumination, illustrated, offering suggestions for carrying out the provisions of the code for greatest efficiency.—Ben B. Hoover.

The Wisconsin Lighting Code. Am. Arch., April 2, 1919, 115, No. 2258, 500.—This is an abstract of the Wisconsin code, revised in 1918, which is the latest regulation of its kind. The code consists of two parts. The introduction refers to the state laws requiring the commission to fix standards for industrial lighting and describes the methods employed in formulating these laws. The application of the rules and definitions of terms employed and the rules themselves conclude the first part. The second part consists of explanations of the rules. The publication is a condensed and comprehensive manual on the subject. It describes also methods for measuring the intensity of illumination and means for providing natural illumination.—G. M. Fair.

Industrial Lighting. *C. E. Clewell.* Am. Jour. Pub. Health, March, 1919, 9, No. 3, 196-199. —A brief discussion of the many aspects of industrial lighting with special reference to its bearing upon industrial hygiene.—G. Fair.

Factory Heating. *A. King.* Dom. Engin., March 15, 1919, 86, No. 11, 466-468; 504.—Hot water heating with forced circulation is found to be a reliable and economical method of factory heating.—G. Fair.

Design of Industrial Exhaust Piping System, Part II. Metal Worker, etc., Feb. 28, 1919, 91, No. 9, 275-277.—A brief discussion of the design of industrial exhaust piping systems from the industrial point of view.—G. Fair.

Opportunity for Better Ventilation in Industrial Buildings. *E. C. Allan.* Dom. Engin., April 12, 1919, 87, No. 2, 44-46.—A general discussion of the advantages of good ventilation in industrial buildings.—G. M. Fair.

Proper Construction for Rain Water Filter. *C. D. Puckett.* Metal Worker, etc., April 18, 1919, 91, No. 16, 491-492.—Details of an arrangement to filter rain water are given. The water is freed from suspended matter by passing upward through charcoal and gravel or coarse sand. —G. M. Fair.

New Code for Automatic Sprinklers. Am. Arch., April 23, 1919, 115, No. 2261, 588-595.— A discussion of the rules for fire extinguishing appliances adopted by the Board of Standards and Appeals of New York City.—G. M. Fair.

Covering Fire Doors and Shutters. Metal Worker, etc. Part 1. March 28, 1919, 91, No. 13, 395-397; Part 2. April 18, 1919, 91, No. 16, 488-490.—A description of the laying of sheets in covering fire doors and shutters with tin.— G. M. Fair.

Improvement in Sanitary Conditions Surrounding Industrial Workers Offers a Rich Field for the Plumbing Industry. Dom. Engin., April 5, 1919, 87, No. 1, 2-4.—A general consideration of the effect of the war upon improving the sanitary equipment of factories.—G. M. Fair.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

The Plant Dispensary. *C. D. Selby.* Mod. Hosp., March, 1919, 12, No. 3, 217-218.—This article contains practical suggestions for the establishment of dispensaries in industrial concerns. Dr. Selby briefly discusses the location, the rooms required, and the equipment of the dispensary.—H. A. Bulger.

Complete Medical Service Pays Big Dividends. *H. H. Smith.* Hosp. Management, April, 1919, 7, No. 3, 36-37.—A brief account of the work of the Medical Department of the American Rolling Mill Co., Middletown, Ohio. No details are given as to equipment. The personnel to-day consists of three full-time doctors, eleven nurses and three clerks. Eight years ago one physician and a small dispensary represented the entire health establishment.

A main hospital complete in every way with operating rooms, wards, etc., is maintained. In addition the company provides a Colored Hospital, Central Works, and Shop Dispensaries and a Physical Examination Department.

A clinical record is kept of each employee, and if this shows his health to be below par he is given a thorough examination with recommendation for a change of work if such alteration appears advisable. Facilities for laboratory work are provided and the extent of the entire health organization is justified not alone from an altruistic point of view but on the basis that it pays. Unfortunately no statistics appear in support of the latter contention.—C. K. Drinker.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Quantity House Production Methods, Construction Branch Emergency Fleet Corporation. Am. Arch., March 5, 1919, 115, No. 2254, 353-358; March 12, 1919, 115, No. 2255, 393-398.— The methods employed by the Construction Branch of the Emergency Fleet Corporation for the purpose of insuring the greatest efficiency in the great problem confronting them, are discussed in detail. The engineering and commercial phases are considered.—G. Fair.

The Town of Kipawa. *T. Adams.* Canad. Engineer, Feb. 27, 1919, 36, No. 9, 260-262.—A short discussion of the engineering aspects relating to the planning of an industrial community.— G. Fair.

The Government Model Villages. *R. S. Childs.* Survey, Feb. 1, 1919, 41, No. 18.—A discussion of the model villages developed during the war from the standpoint of planning and architecture.—C. H. Paull.

Housing Construction at Cradock. Munic. Jour., Jan. 25, 1919, 61.—Some details and labor-saving devices connected with the construction near the Portsmouth Navy Yard of the housing project for five thousand workers.—G. M. Fair.

Housing and Welfare Work. Month. Labor Rev., December, 1918, 7, No. 6, 331-337.—An account of the housing schemes of the Ministry of Munitions in Great Britain.—C. H. Paull.

A Housing Development That Solves the Lodger Problem. Am. Arch., April 23, 1919, 115, No. 2261, 565-569.—A description of the planning and constructing of the Naval Ordnance Housing Development, South Charleston, W. Va.—G. M. Fair.

INDUSTRIAL NURSING

Montgomery Ward Builds Employees' Health. *Jeannette D. King.* Hosp. Management, April, 1919, 7, No. 3, 38.—A general review of the duties and opportunities of the industrial nurse.—C. K. Drinker.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

The Principles of Employing Labor. *E. H. Fish.* Ind. Management, Feb., 1919, 57, No. 2, 81-85.—Section heads: overhead charges; holding men to their jobs; establishing contact; the work of selection; community relations; transportation of labor; restaurant facilities.—C. H. Paull.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

How We Keep Our Men Well. *R. W. Elliott.* Factory, Feb., 1919, 22, No. 2, 247-249.—Dr. Elliott tells how he has succeeded in gaining the co-operation, in his health campaigns, of all types of employees in the plant with which he is connected. One of the most important activities of his department has been the development of a series of thirteen health lessons, which are presented to employees in class groups of from twenty to thirty. Each lesson is organized so that it can be presented in an hour period, forty-five minutes of which is on company time. The lessons cover such subjects of everyday hygiene as food, air, water, exercise, hygiene of the various organs, and hygiene of the industry. The final lesson is devoted to answering questions presented by members of the class. These questions may be asked orally, or may be dropped into a question box provided for the purpose during the presentation of the series of lessons. Not only the workers, but also members of their families are invited to attend the final lesson. It is the purpose of Dr. Elliott to develop, in connection with these lessons, a series of motion pictures which will be staged, as far as possible, by people in the plant. He has also found the bulletin board of valuable assistance in carrying health messages to employees.

To illustrate constructive health measures which have been introduced into the plant, Dr. Elliott has discussed his method of dealing with colds. Besides explaining preventive measures, he has, as far as possible, given simple treatment at the plant before sending employees home. In many cases this has prevented employees from relying on their own knowledge of medicine, and has tended to reduce materially the length of time which they are forced to lose.—C. H. Paull.

WORKMEN'S COMPENSATION AND INSURANCE

Comparison of Workmen's Compensation Laws of the United States up to Dec. 31, 1917. U. S. Bur. Labor Statis., Bull. 240.—For brief review of this bulletin see U. S. Bur. Labor Statis., Month. Labor Rev., December, 1918, 7, No. 6, 318-328.—Katherine R. Drinker.

Workmen's Compensation Legislation of the United States and Foreign Countries, 1917-1918. U. S. Bur. Labor Statis., Bull. 243, September, 1918.—A pamphlet of 477 pages, prepared as a supplement to Bulletin 203 of the same Bureau, published in January, 1917, under the title, "Workmen's Compensation Laws of the United States and Foreign Countries." Bulletin 243 presents the enactments, new and amendatory, made by state legislatures during the year 1917 and up to July, 1918, on the subject of compensation of workmen for injuries. Some changes in foreign legislation are also noted.—Katherine R. Drinker.

Review of Annual Report of Compensation Bureau of New York State. Bull. N. Y. State

Industrial Commission, Feb., 1919, 4, No. 5, 82.—C. H. Paull.

The Basis for Compensation of the Soldier for Cardiac Disease. *J. C. Gittings* and *B. Smith.* Jour. Am. Med. Assn., March 29, 1919, 72, No. 13, 917-921.—This is an interesting summary of the findings used in classifying soldiers with cardiac disease for compensation. Of most value is the grouping of the functional cardiac disorders for determination of disability. As this rests upon detailed technical descriptions the reader is referred to the original article.—C. K. Drinker.

Group Insurance. *H. W. Kimball.* Ind. Management, Feb., 1919, 57, No. 2, 154-156.—Group Insurance, the writer explains, originated seven years ago, and is insurance given by an insurance company covering all or certain groups of employees in an industry. The insurance provides death benefits usually of $500 or $1000. The insurance company bases its premium charge on the character of work, the plant, and the type of workers rather than upon individual medical examinations. It is argued that group insurance is desirable in that it reduces labor turnover, establishes good will, offers a method of reward for continued services, protects the worker's family, and provides a substitute for trade union benefits.

Trade unions on the whole have been opposed to group insurance. Some of the arguments offered against it are that it attracts the worker to the job without giving him protection for longer than his term of service; it is paternalistic in that it performs a function for the worker which he should perform for himself; and from the standpoint of the employer is more costly than an insurance scheme which he might inaugurate himself. However, the idea of group insurance is growing, and the majority of companies adopting it have not discontinued it.—C. H. Paull.

Compulsory Health Insurance. *G. E. Tucker.* Am. Industries, Feb., 1919, 19, No. 7, 24-27.—In opposing compulsory health insurance, Dr. Tucker points out that such a scheme in Germany has tended to develop class distinction, and to blind the worker to the particular employment in which he may find himself. He calls attention to unsatisfactory features of the English system. His argument would tend to show that compulsory health insurance fails to take into account the fundamental principles of the health problem, in that it provides for medical care rather than the development of effective preventive procedure on a large scale. He introduces statistical material to show that in some instances at least death-rates and the spread of certain diseases have been greater in countries adopting compulsory health insurance than in the United States where it does not exist. It is also pointed out that an effective scheme of compulsory insurance in which industries or the government would participate would be exceedingly burdensome from a financial standpoint. The real method of attack, in the opinion of the writer, is to eliminate the very high percentage of preventable diseases arising from unsatisfactory social and industrial conditions and aggravated by prevalent ignorance.—C. H. Paull.

Philadelphia County Medical Society Meeting of Feb. 12, 1919. Jour. Am. Med. Assn., March 22, 1919, 72, No. 12, 888-889.—A summary of the health insurance question as developed by the Pennsylvania Health Insurance Commission. Brief accounts of papers presented by William Draper Lewis, John B. McAlister, M.D., Isadore Stern, and Frederick L. Van Sickle, M.D.—C. K. Drinker.

REHABILITATION OF DISABLED EMPLOYEES

Provision for the Disabled, and Vocational Education. Month. Labor Rev., Dec., 1918, 7, No. 6, 80-89.—The task of the Federal Board for Vocational Education in assisting the crippled or disabled soldier is presented as being five-fold: (1) The vocational adviser of the Federal Board meets the disabled soldier before he leaves the hospital, and discusses with him his preference and aptitude for work and the character of work available for men possessing his handicaps; (2) Preliminary vocational training; (3) Placement in the occupation selected for a probationary period; (4) Final placement in suitable employment as determined by training and probationary experience; (5) Follow-up work for a period sufficiently long to be assured that the individual has found employment which will be permanently agreeable to him.

During the period of training compensation is furnished the disabled soldier by the government. In providing training for men the Federal Board has availed itself of existing agencies, which include schools of all descriptions, industrial and commercial establishments, and where satisfactory courses have not been found, special arrangements for such courses have been made.

In connection with the rehabilitation work of the Ford Motor Company, their chief surgeon reports that about 18 per cent. of the men in the Ford plant are below standard in some respect, and that a majority of these men have been placed in positions where the efficiency of the operation has not been reduced by their employment.

The conclusion of this discussion presents a number of observations by Mr. Baker, superintendant of Queen Mary's Workshops in England. Among other things he advocates that after a man has undertaken training, he should sign a contract to complete his course, providing he has been given sufficient time to judge the merits of the work. Mr. Baker also advocates the establishment of national workshops to be operated on a commercial basis for men whose handicaps will not permit them to compete in privately operated industrial plants.—C. H. Paull.

Classification and Reclassification (Rehabilitation) of Workers. *F. Hijmans.* Nederlandsch Tijdschr. v. Geneesk., Feb. 22, 1919, 63, First Half, No. 8, 577-585.—The writer first discusses the necessity of men being fitted both mentally and physically for the particular job in which they are employed, and says that they should be examined as to their fitness by competent persons, both from the standpoint of physical and of mental ability. To undertake such a scheme, it is necessary to plot out what traits make up the desiderata for certain professions, as well as those which are a contra-indication for engaging therein. This is true in the physical as well as in the psychical sense. There is great need for such classification, both for medical men and for the workmen themselves. The social conditions of working men would be benefited thereby, in a way not to be attained by maximum or minimum wage scales, or by insurance schemes, etc. Employers would get better work; society would be benefited by better health, and hence, better production.

Re-classification is more important than classification, i.e., rehabilitation of incompetent or disabled workers, so that they may not become a burden on the community. Also provision of proper orthopedic appliances, artificial limbs, etc., is of great value. A rehabilitation or re-classification institute should be welcomed by the state insurance banks.

The author would put the practical application of this plan in charge of a special commission, whose business would be to institute an active propaganda to get all classes interested—not only medical men, but sociologists, insurance companies, and especially labor unions. The matter should be run by private subscription, until it reached proportions where the government could subsidize it. Strictly government control is not desirable for many reasons. It takes too long to put anything through, there is too much red-tape and its scope is not broad enough. Also the people would mistrust it and would not take the proper active interest in it.

The institute should serve six purposes:

1. Collection of statistics.
2. Giving of practical advice.
3. Introduction of free technical instruction.
4. Rehabilitation of mental and physical invalids.
5. Maintenance of equilibrium in the labor-market.
6. The discovery of those who have become unfit for their present occupation and the accomplishment of their rehabilitation.

There should be a Central Institute with branches. The branches should be situated in labor centers and should work as independently as possible, doing everything except those things which could be better accomplished by the Central Institute (such as the procuring and manufacturing of orthopedic appliances, the supplying of technical instruction, etc.). The patients could be sent to the Central Institute for examination if this were not possible at the branches, or for special examination or for re-examination.

The Institute would have the following duties:

a. Administration.
b. Scientific examination [illegible] bureaus.
c. Employment and placing of candidates.
d. Scientific research.
e. Propaganda and publicity.
f. Technical instruction.
g. A department for the study, experimentation and trial of orthopedic appliances and other remedial measures.
h. An employment bureau and department for social aid.

—N. C. Foot.

Problems of the Crippled Man in Industry. —*C. Hookstadt.* Month. Labor Rev., Dec., 1918, 7, No. 6, 18-30.—The writer presents a statistical discussion of the effects of injuries upon the future prospects of workers based upon investigations made in Massachusetts, California, Wisconsin, New York City, and Denmark. He points out that the period of total disability varies not only with the character of the injury, but also with the age of the worker. The studies show that opportunity for re-employment by the employer in whose plant the injury occurred varies inversely with the severity of the injury, and that opportunity to return to the same occupation is also seriously decreased with the severity of the injury. These facts naturally lead to a third conclusion: that unemployment tends to vary in the same ratio as the seriousness of the injury. Injuries, on the whole, tend to force the skilled worker into a less skilled type of work. Although full statistical material is lacking, it is apparent that inability to speak English decreases the opportunity of the disabled worker to obtain re-employment.

There is a marked tendency for injured workmen to be re-employed at wages less than they were receiving at the time of the injury, though in some cases they receive more. The tendency for wages to decrease varies in the same direction as the severity of the injury.

The writer points out that the injured workman has been handicapped not only by his injury, but by the psychological state arising out of the new condition in which he finds himself, and also the general lack of interest in him both on the part of the employer and of public agencies. To remedy these conditions he suggests: (1) That present compensation laws be made more definite, and that compensation be increased for most injuries; (2) That adequate medical and surgical assistance be furnished by the state; (3) That the state furnish re-education agencies; (4) That it put itself in a position to guarantee re-employment; (5) That more efficient insurance methods be adopted; (6) That the work of supervision of disabled men be centralized in a state office, preferably connected with the industrial accident commission.—C. H. Paull.

What Sick and Crippled Men Are Doing for the Ford Motor Co. *N. McLeod.* Mod. Hosp., Jan., 1919, 12, No. 1, 1-3.—The idea of employing sick and crippled men in the Ford Motor Co., did not originate entirely from a philanthropic point of view, but rather because the time is approaching when it will be necessary for all concerns employing large bodies of men to take sick and crippled men and place them where they can be used most efficiently.

A man applying for work is examined by the examining doctor who recommends what kind of work he is physically able to do. If the appli-

cant is not physically fit, he is referred to the medical transfer department, where a detailed description of each job and operation in the entire factory is kept and so classified that it is an easy matter to place the new employee, no matter what his disability may be. Nor are all crippled individuals placed in any one department; each department has its own quota. Tuberculous employees, however, are segregated in two different buildings, built especially for them. These men are divided into different groups, the advanced and the moderately advanced cases, and the nature and amount of work chosen accordingly. Most of the work of the tuberculous employees is in the salvage department.

The Ford Motor Co. by this system is taking men who probably need work more than anyone else, and is making profit from them. It is stated that the system of examining employees and choosing work suited for them has proved an excellent investment. It reduces labor turnover and increases the contentment and efficiency of the employees.—H. A. Bulger.

An Experiment in Employing the Blind. *D. Wolf.* Ind. Management, Feb., 1919, 57, No. 2, 105-107.—A series of circumstances led the Miller Lock Co. to employ a number of blind persons in operating their drilling machines during the war. The training of these workers was begun by familiarizing them with the shape and proportions of the material with which they were to work. They were then given general operating instructions, including changing the drills and care of the machine. Some of the operators were able to become producing men in two days' time, while others required a longer period. A supervisor was assigned to them whose duty it was to look after their general needs, providing them with tools, and guiding them about the building as was required.

Although these blind workers have been successful in operating drilling machines, their average production has not reached that of the normal worker. On the other hand it is hoped that they may eventually attain a higher standard of production. While at first they attracted the attention of their fellow-workers, it has been felt that their presence in the factory has tended to improve the morale of the working force.—C. H. Paull.

Major H. R. Allen's Instantaneous Method of Reshaping Tool Handles So That They May Be Used by Deformed or Crippled Hands. *R. W. Shufeldt.* Med. Rec., Feb. 15, 1919, 95, No. 7, 269-273.—Major Shufeldt here describes one of Major Allen's most recent ingenious inventions for the prompt improvement in the use of crippled or deformed hands, and in addition carries the idea a little farther and applies it to artificial hands.

Major Allen has suggested and proved the value of the use of ordinary gelatin and ordinary modelling composition, used by dentists, in making plastic handles for tools and instruments varying widely in their nature. This composition has the property of becoming soft and plastic without running, after several minutes' immersion in hot water. This, when allowed to cool or when plunged into cold water, at once hardens and becomes brittle with the consistency of terra cotta. A mass of this soft mixture is applied to the handle of the tool which is to be used, is moulded to conform to the shape of the palmar surface of the partially closed crippled hand and allowed to harden. It has been shown that with this modified handle the crippled hand can be used with astonishing efficiency.

Major Shufeldt's modification may be applied to artificial arms and consists in making with this composition material a rough model of the hand, which in its plastic condition may be made to hold any tool or instrument desired, and which is then allowed to harden. He has even suggested a single finger for the use of the typewriter. By this means artificial hands may be made infinitely more useful than the artificial hands manufactured at present.—W. H. Alexander.

How to Get "Better-Than-New" Workmen. *J. Heywood.* Factory, Jan., 1919, 22, No. 1, 40-41. —An introduction of the employer to the work of the Federal Board for Vocational Education.—Charles H. Paull.

Productive Occupational Therapy in the Treatment of the Disabilities of the Extremities. *E. G. Brackett.* Jour. Orthop. Surgery, Jan., 1919, 1, No. 1, 40-45.—The author points out that a long convalescence is often the cause of a man's losing his "industrial grip." This is especially important in the soldier. He makes a plea for productive occupational therapy and gives examples of what it means. For instance, a man with a stiff hand that has to be made more flexible should be given *specially adjusted* carpenter's tools and put to work. The most important point in the whole is the adjustment of the tools and work to the condition. In England some work has been done along this line, and the institutions in which it is carried out have a very encouraging air of hopefulness and a morale that is not approached in most of the old-fashioned ones, showing how well this treatment reacts upon the men.—Charles C. Lund.

A Report of the Cleveland and Elyria Cripple Surveys. *W. G. Stern.* Jour. Orthop. Surgery, Jan., 1919, 1, No. 1, 23-32.—This is a short paper on the results of a very thorough survey of the above cities, in a study of the problem of cripples. A very instructive point was that 65 per cent. of cripples in all walks of life were unknown to hospitals, dispensaries or social agencies, and were discovered only on house to house canvass. The ratio of cripples to population was 6:1000. The paper mentions the fact that many were more than self-supporting, but does not show what individuals crippled in different ways did to earn their support. But this and many other important facts could no doubt be learned by reference to the data collected in the survey.—Charles C. Lund.

MISCELLANEOUS

Systematic Care in the Sexual Diseases.—*J. B. Clark*. Jour. Am. Med. Assn., April 26, 1919, 72, No. 17, 1205-1211.—A very thorough article on the care of venereal disease in Camp Logan, Tex.—C. K. Drinker.

Industrial Slaughter-Houses. *Rippert*. Riv. di ingegner. san., 1918, 14, No. 14, 79-81.—In the past the meat industry in European countries has been in a backward state. The municipal abattoirs consist of several buildings, but all are one-story structures and the work is performed on one floor. An industrial slaughter-house is an entirely different establishment. It consists of one building of several stories. The animals are carried to the top floor, where they are killed, and the carcasses are worked up as they pass down through the various floors. While in a municipal abattoir all the various operations are performed by the same men, in an industrial establishment the animal passes from hand to hand, thereby producing a division of labor. It is planned to establish a number of industrial abattoirs in France in the regions where cattle are produced, and to transport the meat in refrigeration cars to the various centers of consumption. It is expected that this system will greatly reduce the price of meat. Another advantage of these industrial abattoirs consists in the fact that the work is performed more cleanly and the general principles of hygiene can be applied more strictly.—Albert Allemann.

Drug Addiction. *W. A. Bloedorn*. Jour. Am. Med. Assn., Jan. 25, 1919, 72, No. 4, 262-265.—A brief general article relating to drug addiction in the navy.—Cecil K. Drinker.

The Problem of the Working Ability and the Earning Capacity of Tuberculous Individuals. *D. Rothschild*. Therap. Monatsh., Oct., 1918, 32, No. 10, 369-380.—Tuberculosis has increased enormously in Germany since the beginning of the war. This is attributed to the fact that at home, as well as the front, under-nutrition and mental and physical strain exist. Furthermore, many individuals, particularly women, have been forced into war occupations entailing heavy and unaccustomed physical labor, frequently in unhygienic surroundings.

Emphasis is laid upon the importance of a careful examination to determine whether a tuberculous person is capable of following some occupational pursuit. The writer is guided mainly in his decision as to the activity of tuberculous lesions by the chest signs, the examination of the sputum and the temperature. Relatively little value is attached to the X-ray and the tuberculin reaction. It is pointed out that it is a mistake to be guided by chest signs alone, since persons with a process involving several lobes may go on working for many years with little embarrassment, whereas a person with practically no signs may run a very bad course.

Stress is laid upon the importance of isolating persons with bacilli in the sputum. It is particularly important to protect children from contact with infectious individuals and it is advisable to separate them from tuberculous parents. Occupations in poorly ventilated, dark rooms or in a dust-laden atmosphere and those necessitating a sitting posture should be avoided by tuberculous persons. Individuals with active lesions should be forbidden to engage in handling or preparing food.—G. B. Wislocki.

An Experiment in Fair Dealing Mod. Hosp., Feb., 1919, 12, No. 2, 144-146.—How the Delaware Hospital and neighboring employers co-operate to secure the best treatment for injured employees where the law is inadequate.—H. A. Bulger.

ABSTRACT *of the* LITERATURE

OF

INDUSTRIAL HYGIENE

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CONTENTS

GENERAL

INDUSTRIAL HYGIENE. *L. I. Harris.* Med. Officer, 1919, 21, No. 2 13.—Industrial hygiene is closely related to child hygiene. Yet when children leave school and enter the workshops the health authorities lose sight of them. Industrial hygiene is an essential feature of public health work and it is the duty of the health authority to watch over children at work and to examine closely the conditions under which they work.

The author of this article, who is a member of the New York Department of Health, has found a large amount of latent disease among the industrial population of the city. The number of cases of disability due to industrial accidents and disease equal those due to war. The number of accidents occurring to industrial workers in the United States during the year 1918 amounts to no less than 1,900,000, and over 22,000 deaths are directly attributable to industrial accidents.

In New York occupational clinics have been established in the various factories. The health officers not only carry on their studies in industrial hygiene but educate the workers to protect themselves better. The old methods of tuberculosis work must be changed. The tuberculosis clinics must become diagnostic stations for the discovery of occupational diseases of all kinds. These clinics must displace those so-called philanthropic institutions which charge from $5 to $25 for an examination. This work must be done at the cost of the community, not only for the poor but also for those of the middle class who cannot afford to pay.—A. Allemann.

INDUSTRIAL HYGIENE AT THE CONVENTION OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

U. S. Bur. Labor Statis., Month. Labor Rev., Feb., 1919, 8, No. 2, 215-219.—A brief account of important speeches.—C. H. Paull.

Congress Should Adequately Support Industrial Hygiene. New York Med. Jour., April 5, 1919, 19, No. 14, 599.—This is an editorial discussing the value of the work done by the U. S. Public Health Service.—W. Herman.

Cost of Health Supervision in Industry. *M. W. Alexander.* Mod. Hosp., May, 1919, 12, No. 5, 376-377.

Cost of Health Supervision in Various Industries

Industry	Number of Establishments Represented	Total Average Number of Employees Supervised	Total Cases of All Kinds	Total Medical and Surgical Cost	Average Annual Cost of Medical and Surgical Supervision per Employee
Metal trades	47	294,646	1,988,991	$541,771	$1.84
Rolling mills	7	49,317	358,574	137,047	2.78
Smelting and refining	1	1,270	2,832	6,932	5.46
Light and power	7	24,921	49,046	92,601	3.72
Transportation	5	35,795	81,591	69,633	1.95
Chemicals	6	10,572	78,744	34,797	3.29
Food	5	13,650	69,565	39,875	2.92
Rubber	5	27,462	234,069	76,089	2.77
Textiles	4	8,939	67,380	24,177	2.70
Paint	2	4,023	10,255	29,635	7.37
Leather	2	3,026	9,440	6,102	2.02
Publishing	2	3,358	6,742	3,473	1.03
Coal mining	1	2,454	2,842	4,637	1.89
Gold mining	1	2,500	62,126	35,590	14.24*
Coal and iron mining	1	11,000	131,898	130,000	11.82*
Miscellaneous	3	2,611	11,019	6,126	2.35
	99	495,544	3,165,111	$1,238,485	$2.50†

*Cost includes treatment for sickness of employees and their families when requested.
†The average annual cost per employee, excluding plants for which the cost includes sickness treatment of employees and their families at home, was $2.21.

This table summarizes data for the year 1916, and supplements the author's compilation for 1915. The average cost of $2.50 is not representative since the total cost on which the average is based includes that of four plants which render unusual service, giving both medical and surgical attention to their employees at the plant and in their homes as well, besides assuming the medical care of the employees' families. Omitting these four plants from consideration, the average cost becomes $2.21 for each individual.

Convincing proof of the economic value of health supervision in industry is afforded by the fact that, when collecting the data contained in this report, it was found that no employer had abandoned the health supervision activities established in his plant. On the contrary, the prevailing tendency has been to invest even more money in extending the service.—C. K. Drinker.

The Care of the Sick in the United States in 1919. *S. S. Goldwater.* Mod. Med., May, 1919, 1, No. 1, 5-12.—This article presents a review of the methods now in operation for the care of the sick in the United States. Certain statistics of industrial interest are given.

1. There is an average of six to ten days of acute illness for each worker in a modern industrial population in one year. On the ten-day basis this would mean that in New York City there are 150,000 sick daily.

2. Various studies have shown averages from 21 per cent. to 40 per cent. of uncared-for illness in industrial communities. In a medical examination drive in South Framingham 77 per cent. of 4,489 persons examined showed some physical disorder or defect requiring medical attention. Self-diagnosis and self-treatment by means of patent medicines is very extensive and not far removed from sheer neglect of sickness. This type of abuse grows better but probably can never be completely eradicated.

3. The character of medical attendance varies with the surroundings of the patient. Where dispensaries are available they are increasingly popular. In New York City 3,468,190 visits were paid by patients to dispensaries in 1915.

Other subjects treated are Lodge and Benefit Fund Practice, State Care, Nursing Care, Public Health Agencies, and Hospitals. Unfortunately space does not permit thorough discussion upon Cost of Medical Care and Industrial Accidents.—Katherine R. Drinker.

The Interpretation of the Death Rate by Climographs. *E. Huntington.* Mod. Med., May, 1919, 1, No. 1, 13-22.—Data are presented which lead the author to the following conclusions:

1. Fairly moist weather is almost invariably more healthful than dry weather of the same temperature, and by inference moist climates are cor-

respondingly better than dry. A mean temperature of 64 F. is apparently most conducive to physical efficiency.

2. Cold waves, unless of extraordinary severity, are distinctly beneficial to health, while a rise of temperature even in winter is harmful. In considering this conclusion a careful distinction must be made between the effects of a drop in temperature, i.e., the wave itself, and a continuance of a low temperature. Continued cold leads to increased morbidity.

3. A variable climate is in general much more healthy than a uniform climate even though the latter has an almost ideal temperature.—Katherine R. Drinker.

MODERN INDUSTRIAL MEDICINE. *C. D. Selby.* Mod. Med., May, 1919, 1, No. 1, 34-38.—A well constructed article outlining the duties and opportunities of the industrial physician. The following headings are covered without detail:

A Selection and Assignment of Workers.
  1. Standardization of Job Requirements.
  2. Physical Examination of Workers.
  3. Vocational Placement of Workers.
  4. Instruction of New and Transferred Workers.
B. Hygienic Supervision of Working Conditions.
  1. Inspections.
  2. Investigations.
  3. Instruction of Foremen and Management.
C. Health Maintenance.
  1. Health Instruction.
  2 Provision and Facilities for Care of Health in the Plants.
  3. Prevention of Communicable Diseases.
  4. Treatment of Trivial Injuries.
  5. Prophylactic and Emergency Dental Attention.
  6. Surgical Treatment.
D. Better Home and Community Conditions.
  1. Social Aid.
  2. Medical Aid.
  3. Community Aid.
E. Enhancement of Knowledge.

—Katherine R. Drinker.

HUMANIZING INDUSTRY. *I. Fisher.* Ann. Am. Acad. Pol. Sc., March, 1919, 82, No. 171, 83-90.—Pages 84 to 86 of this discussion deal with the effect of health on production and morale in industry. "Health is the workers' capital." Unlike the man with financial resources, the worker often has little or nothing to fall back upon when he is not able to work. Not only should he have physical health, but also mental health, and this is dependent upon the workers' ability to satisfy certain fundamental instincts such as self-expression, loyalty, play, etc.—C. H. Paull.

HEALTH CONDITIONS IN SOUTHERN EUROPE. *L. Dublin.* Survey, April 5, 1919, 36-38.—Health conditions in southern Europe have become markedly bad during the war. Even prior to the war countries included in this district made inadequate provision for the protection of health. Influenza, tuberculosis, and malaria have made ravages in Italy. Greece has suffered seriously. Serbia has not only been wasted by epidemic, but the birthrate has been so reduced that the absence of young children is marked. The writer emphasized the need of an immediate organization of effective health work in these countries.—C. H. Paull.

HOSPITAL SERVICE IN RURAL COMMUNITIES. *E. C. Meyer.* Jour. Am. Med. Assn. May 3, 1919, 72, No. 18, 1290-1293.—In 1910, the United States had three times as many physicians in proportion to the total population as the most favored nation in Europe. During the early life of a country with scattered population large numbers of physicians are needed, but as the population becomes more dense the necessity for the same proportionate number of physicians decreases. In 1904 there were 5,747 graduates from our medical schools, in 1918 but 2,807, a decrease directly referable to improvement in standards. Even in spite of this, in 1918 there was more than twice the number of physicians in this country than in the most favored countries of Europe. There has been justifiable dissatisfaction with the quality of medical service, but this should give way rapidly as the better educated young men reach practice.

The cities average better and more medical service than the country, and different sections of the United States are supplied in a very varied manner.

"The rural South has the poorest medical service. The states of the Mountain and Pacific divisions come next, with the middle Atlantic states, New York, New Jersey and Pennsylvania, fourth.

"What the rural regions appear to need most is not a greater number of physicians, but more wise and extensive use of the medical facilities which both country and city at present offer. . . . The development of efficient public health administration, better distribution in certain areas of private practicing physicians, harmonious cooperation between public and private health service, and intelligent demand for medical service—these are the things toward which the open country must strive."

Statistics then follow on the adequacy of medical care in 13,132 cases covered by the surveys of the Metropolitan Life Insurance Company. While it is hard to collect such figures, the results gained indicate a shocking inadequacy in both hospital and private practice. The results in the former case are of considerable interest industrially since the "inadequacy" seems to be due to lack of social service and follow-up work.—C. K. Drinker.

HOSPITAL SERVICE IN RURAL COMMUNITIES. *E. C. Meyer.* Jour. Am. Med. Assn., May 10, 1919, 72, No. 19, 1365-1367.—Lists in a brief, general way the services a rural hospital may render the community.—C. K. Drinker.

HOSPITAL SERVICE IN RURAL COMMUNITIES. *E. C. Meyer.* Jour. Am. Med. Assn., May 17, 1919, 72, No. 20, 1460-1463.—Part IV of Mr. Meyer's review contains a summary of laws making rural hospital compulsory or optional, and terminates by giving the technique of a survey by which information might be gained leading to legislative or community action toward the establishment of efficient rural hospitals.—C. K. Drinker.

THE SANKEY REPORT. Nation, May 3, 1919, 118, No. 2809, Sect. II.—A report of the British Coal Industry Commission, giving the recommendations accepted by the government as to hours and wages, nationalization, etc.—Hazel Andrews.

Labor Conditions. State Conn., Bur. Labor Statis., 28th Report for the Two Years Ending Nov. 30, 1918, 29-39.—A brief description of conditions during the war, and since the signing of the armistice. A table is appended "showing the wages of outside labor in a number of the larger places in the state."—Hazel Andrews.

Occupational Diseases. State Conn., Bur. Labor Statis., 28th Report for the Two Years Ending Nov. 30, 1918, 28.—"A summary of the number of cases and the nature of the diseases." Six localities reported. The significant feature is the large number of cases of fulminate rash centering in Bridgeport.—Hazel Andrews.

Sixth Annual Report, State of Tenn., Dept. of Workshop and Factory Inspection, Jan. 1, 1918, to Dec. 31, 1918:

Changes in Method.—New methods of reporting accidents, and issuing working certificates to minors are given. Advances are reported in the matter of safety.

General Work of the Department.—Tables are printed under this head giving the actual official records referring to the inspections made. The new form for the general report is reproduced.

Women Labor in Tennessee.—The state laws governing female employment are stated, and a statistical report of inspections for female labor is given. Photographic illustrations of model factory conditions for girls are shown. The employment of women in war industries is described.

Regulation of Child Labor.—A digest of the child labor laws with the report of inspections for child labor.

Treatment of Industrial Hazards.—A digest of the accident prevention laws of Tennessee is given. Industrial accidents and their prevention are given special treatment. A large number of photographs are reproduced showing methods of safeguarding machinery. There are special sections on workingmen's compensation, fire protection, sanitation, septic tank system of sewage disposal, ventilation, foundry bath law, and regulation of the mattress business.—Hazel Andrews.

Tenth Annual Report of the Commission of Agriculture, Commerce and Industries of the State of South Carolina. 1918. Labor Division, Factory and Inspection and Manufacturing Statistics. *W. D. Holland* and *G. H. Lucas.*—This report deals principally with manufacturing conditions, but considerable mention is made of the administration of the laws regarding child labor and the employment of women. Sanitary conditions as they exist in certain industries, especially in the mills, are discussed in some detail.—Hazel Andrews.

Narcotic Drug Addiction as Regulated by a State Department of Health. *T. S. Blair.* Jour. Am. Med. Assn., May 17, 1919, 72, No. 20, 1441-1445.—By an act of the Pennsylvania General Assembly, session of 1917, concurrently with the United States Congress, the Harrison Narcotic Law, to all intents and purposes, was placed on the statute books of the commonwealth. The Commissioner of Health was authorized to establish, in the Department of Health, a bureau or division for the purpose of enforcing the provisions of the act, to require reports to the bureau, and, under the powers conferred on him, to issue rulings and orders necessary for enforcement. The result has been a considerable accumulation of facts on drug addiction which have obvious industrial applications.

1. The larger number of bad reports on drug addiction came from communities with 3000-30,000 population, there being more unrestrained addiction in such places than in the large cities.

2. Prescriptions from physicians constitute the main source of supply. Smuggling and forging of prescriptions constitute other important sources.

3. Codein, morphine, various preparations of opium, and lastly heroin are the narcotic drugs most frequently prescribed, and are arranged in order of frequency. Paregoric, being exempt under the Harrison Law, has become extraordinarily popular.

4. The greater proportion of the worst medical violators of the narcotic laws are men past 50 years. "Empiricism largely accounts for the aged addict and the aged medical offender against the narcotic laws."

5. The best results seen in treatment have been in prisons, for obvious reasons. The gradual reduction method appears to be a failure.

6. Despite plentiful warnings, heroin seems to be displacing codein as a cough sedative, and largely because it costs less. With the rapid growth of the heroin habit before us we should insist that the manufacture of this drug be entirely suppressed.

7. The author believes that there should be a government monopoly on all narcotic drugs with an official in every district absolutely regulating the supply.—C. K. Drinker.

The Drug Evil and the Drug Law. *C. F. Collins.* N. Y. City, Dept. of Health, Month. Bull., Jan., 1919, 9, No. 1, 1-24.—A discussion by Cornelius F. Collins, Justice, Court of Special Sessions, City of New York, of the drug evil and of the "Narcotic Drug Law" of the State of New York.—Katherine R. Drinker.

The Department of Health's Clinic for Drug Addicts. N. Y. City, Weekly Bull., Dept. of Health, April 19, 1919, N. S. 8, No. 16, 121-122.—A clinic has been established by the Commissioner of Health, known as the Narcotic Relief Station, wherein addicts may secure free treatment.—Hazel Andrews.

Statistics of the Narcotic Relief Station. N. Y. City, Weekly Bull., Dept. of Health, May 3, 1919, N. S. 8, No. 18, 137-139.—"The occupation of the various addicts, as given, shows that 44 per cent. (624) were skilled; and that the work of 236 (17 per cent. of the total) of these was connected with transportation." Detailed statistics as to drug used, race, age, sex, occupation, causes for taking drug, duration of addiction are given.—Hazel Andrews.

EDUCATION OF THE WORKMEN IN SLAUGHTER-HOUSES TO CLEANLINESS. *K. Lohoff.* Ztschr. f. Fleisch- u. Milchyg., 1918, 28, No. 18, 244-246.—It is the duty of the meat inspectors in municipal slaughter-houses to educate the men to cleanliness. This should not be done in an obtrusive manner, but in occasional quiet talks to the men. They should be impressed with the following facts: Danger of infecting the meat through uncleanliness; importance of keeping the tools always clean; avoidance of cutting into encapsulated infection foci; avoidance of soiling the meat by intestinal contents. Diseased organs should never be brought in contact with sound meat. The men should not smoke, as the cigar coming in contact with diseased meat may infect a man's own mouth. Flowing water in all slaughter-houses is essential, so that the hands and tools can be washed at any moment.—A. Allemann.

"CLEANLINESS IS AKIN—." *D. W. Moore.* System, Mar., 1919, 35, No. 3, 501-502.—A brief statement of the Holley Carbureter Co. of the value of cleanliness in the workshop in attracting high-class workmen.—C. H. Paull.

AN APPARATUS FOR THE AUTOMATIC ESTIMATION OF SMALL AMOUNTS OF OXYGEN IN COMBUSTIBLE GAS MIXTURES OR OF COMBUSTIBLE GASES IN AIR. *H. C. Greenwood* and *A. T. S. Zealley.* J. Soc. Chem. Indust., Apr. 15, 1919, 38, No. 7, 87-90.—An automatic device for the detection and estimation of combustible gases (hydrogen, methane, etc.) in air, of oxygen in hydrogen, etc., depending upon the decrease in volume caused by the glowing of a platinum wire in such mixtures. The amount of contaminating gas present may be determined by direct observation of the decrease in volume; or a continuous record may be made by transmitting the volume change to a column of mercury in which a fine platinum wire is partially immersed, the resistance of the exposed portion of this wire showing the amount of contamination. By means of still another attachment, a bell is made to ring when the per cent. of contaminating material exceeds a predetermined limit.—C. H. Fiske.

AN APPARATUS FOR THE ADMINISTRATION OF GASES AND VAPORS TO ANIMALS. *E. K. Marshall, Jr.* and *A. C. Kolls.* Jour. Pharmacol. and Exper. Therap., Mar., 1919, 12, No. 8, 385-391.—An apparatus, based on one used by Lehmann, is described for studying the effects of measured amounts of gases and vapors upon animals. The apparatus of Marshall and Kolls is said to be somewhat simpler and more convenient, as well as more generally applicable than Lehmann's apparatus.—W. Hale.

MEDICAL SCHOOL INSPECTION. N. Y. City, Dept. of Health, Weekly Bull., Jan. 4, 1919, N. S. 8, No. 1, 1-3.—This article contains the statistics of the results of medical school inspection in New York City during the years 1913-1917, inclusive.—Katherine R. Drinker.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

CIRCULATION

TESTS OF THE FUNCTIONAL CAPACITY OF THE CIRCULATION. *M. H. Kahn.* Am. Jour. Med. Sc., May, 1919, 157, No. 5, 634.—This article gives some data on comparative functional tests in normal individuals and in individuals with neurocirculatory asthenia and allied conditions. To appreciate the article one must see the diagrams and charts presented. The use of these methods may be of value in testing the efficiency of certain individuals.—G. B. Minot.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

INDUSTRIAL POISONING IN AMERICAN ANILIN DYE MANUFACTURE. *Alice Hamilton.* U. S. Bur. Labor Statis., Month. Labor Rev., Feb., 1919, 8, No. 2, 199-215.—A brief summary of a very difficult and important field of industrial toxicology. Readers requiring fuller details are referred to an article by Dr. Hamilton scheduled to appear in the September, 1919, number of *The Journal of Industrial Hygiene.*

A short account of the known causes of dye toxicity is followed by a summary of manufacturing methods. Then follow nine pages giving the physiological action of the principal dyes and dangerous substances used in their manufacture. The compounds covered are: Anilin, benzene, paranitranilin, metanitranilin, dimethylanilin, diethylanilin, anilin chloride, mononitrobenzene, dinitrobenzene, dinitrochlorbenzene, the nitrophenols, benzyl chloride, phosgene, dimethyl sulphate, and sulphuretted hydrogen.—C. K. Drinker.

THE ACTION OF BENZOL. V. THE DIPHASIC LEUCOPENIA AS A POLYNUCLEAR AMPHOPHILE PHENOMENON (RABBIT). *H. G. Weiskotten* and *H. S. Steensland.* Jour. Med. Research, Mar., 1919, N. S. 34, No. 4, 485-494.—This paper is the fifth of a series of papers upon the action of benzol on the blood in rabbits. The diphasic character of the leucopenia following subcutaneous injections of olive oil-benzol mixture in rabbits is mainly a polynuclear amphophile phenomenon and is only to the extent of about one-sixth, a small mononuclear phenomenon.—G. B. Minot.

CARBON MONOXIDE POISONING. *A. J. Lanza.* Mod. Med., May, 1919, 1, No. 1, 45-46.—A brief

statement of the effects of carbon monoxide. Presents no new facts.—C. K. Drinker.

A Symptom in Arsenical Polyneuritis. *R. A. Mees.* Nederl. Tijdschr. v. Geneesk., Feb. 1, 1919, 63d year, 1st half, No. 5, 391-396.—Mees describes the presence of transverse white bands appearing on the finger and toe nails of patients who had taken overdoses of arsenic with suicidal intent. These transverse white bands were 1½ mm. in breadth, had nothing to do with the lunula, the nail above and below being normal, and gradually grew out with the nails. All the finger and toe nails of the patients showed the same phenomenon. The bands on the toe nails were, however, less prominent than those on the fingers, probably on account of shoe pressure. Two of Mees's patients were alcoholic, so that it was difficult to decide whether alcohol or arsenic was the cause of the polyneuritis. The author believes the transverse white bands on the nails, however, to be diagnostic of arsenic.—N. C. Foot.

A Consideration of the Permeability of the Intact Skin to Lead (A Preliminary Communication). *O Süssman* München. med. Wchnschr., Dec. 10, 1918, No. 50, 65th year.—Süssman reports four experiments on cats with emphasis on the following points of control:

1. The animals are kept in the personal laboratory of the experimenter for constant observation.

2. The cages are lead free and provided with contrivances for catching and preserving the urine.

3. The greatest possible care is taken that the food and utensils contain no lead.

4. For a week before the actual experiment starts the animals are allowed to become accustomed to the bandages so that they no longer try to free themselves.

5. It is absolutely essential to prevent breaks in the continuity of the skin.

6. The utmost attention is given to the application of the bandage, which is made water and oil tight and consists of gauze, wadding, Billroth batiste, gelatine foil and collodian, and over all a lined covering of oil cloth.

7. The solidity of the bandage is controlled by careful inspection of the outer layers and margins at the end of the experiment.

8. A complete collection and analysis of the feces and urine is made not only during the experiment, but for a short time before.

The application consisted of 10 to 25 gm. of lead oleate well mixed with vaseline, except in one instance, when 5 gm. of lead oxide was made into a salve with cat fat. The skin surface exposed varied from 50 to 150 sq. cm.

The results are tabulated as follows:

Cat. No.	Application	Surface Exposed in Sq. Cm.	Duration of Exposure in Days	Mg. of Recovered Lead					Average Daily Absorption per Dm. of Exposed Skin
				Feces	Urine	Body	Total	Daily Excretion	
1	5 gm. lead oxide, without rubbing	50	17	0.7	0.8		1.5	0.09	0.18 mg.
2	10 gm. lead oxide, without rubbing	75	19	1.4	1.1	0.2	2.7	0.14	0.19 mg.
3	20 gm. lead oleate, rubbed in	120	47	2.9	2.2	0.6	5.7	0.12	0.10 mg.
4	25 gm. lead oleate, rubbed in	150	15	1.1	0.7	0.9	2.7	0.18	0.12 mg.

It would seem to the author that poisonous effects could hardly be expected from such a low rate of absorption. Further studies are planned, however, to see if similarly controlled experiments on other animals and with other preparations of lead will yield similar results.—H. F. West.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Some Observations on the Recent Influenza Epidemic with Special Consideration of Its Course Among the Working People. *E. Tedeschi.* Riforma med., Jan. 4, 1919, 35, No. 1, 4-6.—The mortality statistics of influenza show that the working classes suffered rather more than the others. Among the workers the thoracic form of the disease prevailed. It is a well known fact in occupational pathology that inhaled dust particles are transported through the lymph current to the peribronchial glands producing enlargement of these organs. The enlargement is usually moderate and is only recognized by means of the X-ray, but in many cases the enlargement is so marked that it gives rise to symptoms of compression and mediastinal phenomena. It is evident that these glands, thus changed by dust particles, become a favorite place for the virus of influenza setting up marked congestive and inflammatory processes.

The female workers suffered more severely from the epidemic than the men. This was especially

noticed among the cigar makers at Sestri Ponente. It is a well known fact that women tobacco workers are especially exposed to disturbances in the genital sphere. Now during the influenza epidemic at Sestri Ponente it was noticed that in pregnant women working in tobacco factories the course of the disease was not only severer but many cases of spontaneous abortion and premature birth were observed.—A. Allemann.

The Prevention of Tuberculosis in Industry. *D. B. Armstrong.* Mod. Med., May, 1919, 1, No. 1, 51-53.—Gives a brief review of the Framingham experience in this regard.

Distribution of Tuberculosis Cases According to Age Group

Groups of Cases During Demonstration	Total, All Ages	16-45 Years	Per Cent in Industrial Age
Deaths	29	16	55
Cases lost to other communities	32	21	65
Cases under treatment in out-of-town institutions	22	15	68
Cases under treatment at home	159	94	59

Better medical service in industrial establishments will improve these figures, which are in no way unique for industry.—Katherine R. Drinker.

Disabled in the Line of Duty. *G. M. Price.* Survey, March 22, 1919, 889-890.—Dr. Price points out the imperative need for greater facilities for caring for tuberculous soldiers and civilians. He calls attention to the fact that some of the buildings which were constructed for war emergency purposes could well be used as hospitals and sanitoria. Through the activities of the Federal Board of Vocational Education steps are already being taken to provide vocational guidance and training for patients who have satisfactorily completed their medical treatment.—C. H. Paull.

Employment of Persons Suffering from Infectious Venereal Disease. N. Y. City Dept. of Health, Weekly Bull., March 1, 1919, N. S. 8, No. 9, 67.—Attention is called to the provision of the Sanitary Code concerning the employment and examination of those suffering from venereal disease.—Hazel Andrews.

Extension of the Department of Health's Venereal Disease Work. N. Y. City, Weekly Bull., Dept. of Health, April 26, 1919, N. S. 8, No. 17, 129-131.—Ten new clinics for venereal disease have been established, the functions of which are to be chiefly advisory and diagnostic. These clinics will also have preventive and educational functions.—Hazel Andrews.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Report of a Case of Steel in the Larynx. *F. Allport* and *B. Wilson.* Jour. Am. Med. Assn., May 3, 1919, 72, No. 18, 1285.—A man shearing tie-plate bars in a steel mill was struck in the neck just below the chin by a steel fragment.

Sometime later—the man having had constant difficulty with speech—laryngoscopy revealed an immobility of the left vocal cord and the whole larynx was moderately inflamed. A roentgenogram showed the metal passing apparently through the thyroid cartilage of the larynx. The steel was removed under local anesthesia with entire recovery.—C. K. Drinker.

Hazards in a Garage. *C. C. Rausch.* Safety, March-April, 1919, 7, No. 3, 57-72.—Accidents in garages are frequent and often serious in nature. Mr. Rausch considers the various hazards encountered and the avoidance of accidents. Gasoline, air pressure, acetylene, storage battery, oil, repair, washing and fire hazards are discussed.—G. M. Fair.

A Great Safety Show. Bull. N. Y. State Ind. Com., Jan., 1919, 4, No. 4, 62-67.—An account of the recent state Industrial Safety Congress with reports from various bureaus working under the Industrial Commission.—C. H. Paull.

Machinery Lay-Outs. *P. C. Spence.* Bull. N. Y. State Ind. Com., Jan., 1919, 4, No. 4, 68-70.—A discussion of the best methods of locating machinery, belting, etc., so as to reduce accident risk.—C. H. Paull.

Two-Hand Tripping Device for Punch Press. *C. C. Rausch.* Safety, March-April, 1919, 7, No. 3, 72-73.—The two-hand tripping device requires the use of both hands of the machinist simultaneously in operating the starting mechanism. The device illustrated is operated by compressed air.—G. M. Fair.

On Protecting Shafting, Belting and Pulleys. Am. Industries, Safety Supplement, April, 1919, 19, No. 9.—C. H. Paull.

Safety Rules for Oxy-Acetylene Welding. Machinery, April, 1919, 25, No. 8, 733-735.—This article contains the rules adopted by the Western Pennsylvania Division of the National Safety Council for all who are engaged in oxy-acetylene welding or cutting operations and for the transportation and care of oxygen and hydrogen tanks.

These rules also cover the necessary devices and fittings on the equipment, the care, operation and handling of oxygen and hydrogen tanks.—R. M. Thomson.

Industrial Use and Limitations of Respirators, Gas Masks, and Oxygen Breathing Apparatus. *A. C. Fieldner.* Bull. N. Y. State Ind. Com., March, 1919, 4, No. 6, 109.—This is a brief article on a subject which is treated by the same author in *The Journal of Industrial Hygiene,* June, 1919, Vol. 1, p. 89. Those interested will do well to refer to the latter publication.—C. K. Drinker.

Extinguishing and Preventing Oil and Gas Fires. Mech. Engin., May, 1919, 41 No. 5, 436-437.—For the past three years the Bureau of Mines has been conducting investigations to determine the nature and the specific causes of oil and gas fires, with a view of suggesting means whereby they may be successfully combatted, and even eliminated, if possible. In a bulletin recently issued by the Bureau, C. P. Bowie points out what has been done by operators in the past, and describes various fire-prevention methods and fire-fighting apparatus which are being used or adopted by many large oil companies. These methods and apparatus are discussed in detail.—G. M. Fair.

Instructions for Safe Use of Pulverized Fuel. Engineer April 25, 1919, 127, No. 3304, 398-399.—Pulverized coal fuel involves certain elements of danger due to inflammable and explosive properties, as is the case also with oil and gas fuel. In order to insure efficient service and to avoid accidents, therefore it is necessary to provide careful handling by men properly instructed as to the conditions. Since accidents might tend to bring this comparatively modern system of fuel into disrepute, a set of rules and instructions relating to the preparation, storage, and use of pulverized coal has been prepared by the Pulverized Fuel Equipment Co. of New York. The rules are given with some supplementary information from another company.—G. M. Fair.

INDUSTRIAL SURGERY

Primary and Delayed Primary Suture of Gunshot Wounds. *F. Fraser* and *collaborators.* Brit. Jour. Surg., July, 1919, 6, No. 21, 92.—Wide excision of the contaminated tract was not undertaken. Instead a thorough removal of all contaminated or dead tissue was found satisfactory. Careful bacteriological work proved that the one important organism to look for was the hemolytic streptococcus.—C. C. Lund.

Primary Suture of War Wounds. *R. T. Vaughan.* Surg. Gyn. and Obst. (Internat. Abstract Surg.), April, 1919, 28, No. 4, 281-294.—A careful, collective review of the subject, bringing together the results of all the work in the various armies. A very large bibliography is appended. —C. C. Lund.

A Reversible and Adjustable Elbow Splint. *W. W. Lasher.* Jour. Am. Med. Assn., May 3, 1919, 72, No. 18, 1282.—A simple elbow splint is described, the details of which are readily appreciable in the illustrations accompanying the article.—C. K. Drinker.

Acute Septic Infections of the Fingers. *A Bamberger.* Mod. Med., May, 1919, 1, No. 1, 43-44:

1. Hydrogen peroxide should not be used as a first-aid cleansing measure; the oxygen liberated forces infection into the tissues.
2. Early diagnosis of osteomyelitis and excision of necrotic bone are important.
3. Large incisions are called for in all infections of the fingers.
4. The use of gutta-percha tissue as drainage material instead of gauze is advisable.—Katherine R. Drinker.

The Treatment of Burns. *A L. McDonald* Ann. Surg., March, 1919, 69, No. 3, 312-317.—Dr. McDonald concludes from his experiences that the following principles govern treatment:

"In the first-aid care of extensive burns, the dressing with gauze soaked in 10 per cent. or stronger bicarbonate and kept moistened, is the simplest and gives greatest comfort. This is preferable to attempts at a more complicated technic. Morphine should be used to give rest, but must be administered with care, since there is often severe reaction and depression and the drug may do harm. Treatment of shock with posture, heat, hot drinks and stimulants may be necessary.

"Paraffine is much preferable to gauze with oily dressings and should be substituted as soon as possible, at least within thirty-six hours. With use of air pump and atomizer the method can be simplified and rendered quite painless; dressings on gauze should be abandoned.

"Dichloramine T in oil is painful and of slight value. If there is extensive slough, wet dressings or antiseptic powders are preferable.

"The use of adhesive strapping over the raw surface is highly satisfactory and simplifies the treatment since dressings may be extended to two or three days.

"The general condition of the patient must be carefully followed and built up by stimulants, tonics or transfusions.

"Skin grafting is rarely necessary nor does it offer much advantage to the healing with paraffine or adhesive."—H. A. Bulger.

Flat Feet and Leg Muscle Strain Related to Industry in Cause. *D. V. Baker.* Boston Med. and Surg. Jour., May 15, 1919, 180, No. 20, 554-556.—Baker points out that flat foot and leg muscle strain are very important common sequelae of industrial trauma, and that they cause monetary loss to the workman, a financial loss to the employer, and loss to the insurer.—G. B. Minot.

FATIGUE AND OCCUPATIONAL NEUROSES

Fatigue in Irritable Heart and Other Conditions. *J T. King, Jr.* Arch. Int. Med., April, 1919, 23, No. 4, 527-536.—Among King's conclusions, the following is the most important: The

quantitative estimation of fatigue by the white vasomotor reaction is of value in the study of clinical conditions. Owing to the various sources of possible error in the test, it is more suitable for group study than for individual cases.—G. R. Minot.

Fatigue Disease as Exemplified in Functional Disorders of the Stomach and Thyroid Gland *J. Rogers.* Arch. Int. Med., April, 1919, 23, No. 4, 498-510.—This article gives a brief discussion of corresponding functional diseases in two apparently unrelated organs, and is intended chiefly to show the probable location of the primary lesion, namely, in the end plates, or terminal filaments of nerves, which have generally been regarded as of negligible importance. He points out that fatigue is to be looked upon as a diseased condition.—G. R. Minot.

Neurasthenia a Growing Disease in Engineering Work. *C. C. Sherlock.* Engin. N.-Rec., May 8, 1919, 82, No. 19, 918.—Neurasthenia is becoming more and more common in the civil engineering field. Mr. Sherlock discusses the symptoms and the methods of treatment.—G. M. Fair.

NUTRITION AND METABOLISM

Calibration of a Dock Laborer by Means of His CO_2 Discharge The Cost of Mechanical Work in Terms of CO_2 Expired. The CO_2 Ordinate of a Dock Laborer (Tom King) During Six Days' Work. (Winter hours, 7.30 A. M. to 12; 1 P. M. to 4.30.) *A. D. Waller,* Proc. Physiol. Soc., Jour. Physiol., March 25, 1919, 52, No. 5, xlviii-l; l-li; lix-lx.—These three communications have to do with the metabolism of men at heavy work, estimated from CO_2 production during brief intervals. A curious increase in oxidation from hour to hour is recorded. Its maximum seems to be reached at the end of the day, when the work, presumably, is least productive. A most interesting comparison is made between the metabolism of a man doing time-work (284 calories per hour) and that of the same man at piece-work of the same kind (430 calories per hour).—P. G. Stiles.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

The Falling Sickness of Divers. *A. Bornstein.* Berl. klin. Wchnschr., Dec. 16, 1918, 55th year, No. 50, 1198-1200.—The writer describes a condition occurring in divers, resulting from the use of a tubeless diving apparatus with a rubber suit and rigid helmet. The symptoms arise while the diver is making a rapid, frequently accidental, descent in the water, and consist of the sudden development of dyspnea, sense of pressure about the chest; rapid, shallow respiration; palpitation, congestion of the head and ringing in the ears.

The symptoms are due, according to the writer, to the fact that, while the diver is sinking rapidly, under certain conditions, a low atmospheric pressure develops within the rigid helmet and the head and respiratory tract in consequence are subject for a varying interval to a lower pressure than would correspond to their depth in the water.

The outcome is usually not serious, because pressure equilibrium is quickly restored within the helmet, but deaths are said to have resulted in several instances. The writer was able to produce in himself a similar train of symptoms by diving into an especially constructed tank. By attaching a manometer to the helmet of the diver it was possible for an observer to record the pressures within the helmet during a rapid descent. Malaise was felt whenever the pressure within the helmet fell below that on the outside.—G. B. Wislocki.

WOMEN AND CHILDREN IN INDUSTRY

Employment of Children in Agriculture. Med. Officer, 1919, 21, No. 6, 42.—The Kent Education Committee reports that during 1917, 1805 licenses were granted to boys and 637 to girls to work on farms during the summer months and 762 boys over thirteen were permitted to work in the country also during winter. All the children were examined after their return to school by the medical inspectors. It was found that as a general rule, the children were greatly improved both physically and mentally. Noteworthy was the effect on children of inferior mentality. Boys who had been hopelessly dull were examined six months after re-entering school and they showed a keen mind, great interest and greatly increased power of perception.—A. Allemann.

INDUSTRIAL SANITATION; ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

PRESENT STATUS OF INDUSTRIAL LIGHTING CODES. *G. H. Stickney.* Am. Arch., May 14, 1919, 115, No. 2264, 694-698 (To be continued).—The following abstract of the paper presented before the 349th meeting of the American Institute of Electrical Engineers is given, together with the original paper.

In order to protect workers from accident and eye-strain, industrial lighting codes have been adopted in four states and in federal establishments. Similar action is under consideration in several other states and there is prospect of extension throughout the country.

Investigation and experience indicate the need of government regulation of factory lighting. When adopted by industrial commissions under authority granted by legislatures, the codes become, in effect, state law. Variations in the codes as adopted are less than might appear, some features being experimental. The existing codes correspond in essentials to the Illuminating Engineering Society code, on which they are based.

Mandatory regulations are necessarily limited in function to the assuring of safety. Higher standards are essential for efficient production. Popular education in which electrical and illuminating engineers can co-operate, is an important feature of future development.—G. M. Fair.

COMMON SENSE, SCIENCE AND DRINKING FOUNTAINS. *J. H. Dunlap.* Am. City, May, 1919, 20, No. 5, 470-472.—The need of mouth guards on bubbling fountains, the dangers of the vertical-jet-fountain and the advantages of the slanting-jet-fountain are discussed. "Less art and more common sense" might well be the slogan of a crusade against many types of so-called sanitary drinking fountains now on the market.—G. M. Fair.

DESIGN FEATURES OF SEWAGE DISPOSAL PLANT AT INDUSTRIAL HOUSING DEVELOPMENT OF ALANWOOD IRON AND STEEL CO. AT SWEDELAND, PA. *G. L. Robinson.* Munic. Eng., April, 1919, 56, No. 4, 135-136.—A condensed description of the elements of the disposal plant, consisting of screen chamber, settling tank, syphon chamber, sprinkling filter, sterilizing outfit, and sludge beds.—G. M. Fair.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

INDUSTRIAL MEDICAL AND DENTAL CLINICS IN THE WOMEN'S GARMENT TRADES. *G. M. Price.* Mod. Med., May, 1919, 1, No. 1, 47-50.—This paper describes the operation of the Joint Board of Sanitary Control in the Women's Garment Trades of New York City, which has been in existence for the last six to eight years.

In 1910, at the close of cloak and skirt workers' strike, one of the provisions of settlement created a Joint Board of Sanitary Control, "said board to be empowered to establish standards of sanitary conditions to which the manufacturers and the unions shall be committed and which both sides obligate themselves to maintain to the best of their ability and to the full extent of their powers." In January, 1913, the dress and waist industry was also taken over and the board exercised sanitary control over 75,000 workers, men and women. There was thus brought into existence by the workers themselves and under their control a means for surveying, investigating, establishing standards of safety, sanitation, lighting, ventilation, etc., in over 2700 shops. It became evident very early that hygiene without reference to the individual workers would be inefficacious. As a result many physical examinations have been made and for the last two years the unions have demanded such an examination for admission. This examination is apparently very thorough, both men and women physicians being used.

Special clinics exist for eye, ear, nose, throat, and dental work. In all cases the employees pay for what they receive. Thus during 1918 the dental clinic treated 7,465 patients and had an income of $12,576.73, with a deficit of $292, an average charge of $2.50 being made for each hour's work.

The main significance of these clinics lies, of course, in the fact that they are conducted, financed and managed by the workers themselves for their own benefit.—C. K. Drinker.

SAVINGS TO A MANUFACTURING CONCERN IN A PLANT DISPENSARY. *J. T. Seller.* Mod. Hosp., May, 1919, 12, No. 5, 377.—The Greenfield Tap and Die Corporation, Greenfield, Mass., has employed a trained industrial nurse during the past nine months and has maintained four fully equipped emergency rooms under the supervision of assistant nurses—chosen from individuals in the plant who have shown special aptitude for the work.

The author figures that this health installation has saved his company $1,750 in obviating lost time from accidents, and $2,500 in preventing lost time from disease.

The nurse, employed under the supervision of the employment department, has made numerous home visits.—Katherine R. Drinker.

IT COSTS ONLY $2.32 APIECE TO KEEP WORKERS FIT. Factory, March, 1919, 22, No. 3, 472.—A brief note on the First-Aid Department of the Holtzer-Cabot Electric Co., which reviews the activities of a simple dispensary installation apparently in charge of a nurse, costing $2.32 a year per employee. No mention is made of employment of a physician.—C. K. Drinker.

INDUSTRIAL, PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

THE HOUSING PROBLEM. Med. Officer, 1919, 21, No. 1, 1.—Already before the war there was a great lack of dwellings for workingmen. During the war the overcrowding became still worse, as few new workingmen's dwellings were erected. The Local Government Board is now trying to remedy this condition. On account of the difficulty of securing labor and the high prices of materials, private enterprise cannot be relied upon to undertake this task. Either public utilities societies, local authorities, or the state itself, must solve this problem. State landlordism is not desirable and the public utilities societies in this field are still in an experimental stage. The local authorities must therefore take up this work; they are best fitted for choosing sites, assessing the housing needs and determining the number and kind of houses.—A. Allemann.

BETTER HOUSING—WHAT IT ASKS OF THE PHYSICIAN. *C. C. May.* Mod. Med., May, 1919, 1, No. 1, 70-72.—An appeal for better industrial housing.—C. K. Drinker.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

HOURS OF WORK AS RELATED TO OUTPUT AND HEALTH OF WORKERS. WOOL MANUFACTURING. Nat. Ind. Conference Board, Research Report No. 12, Dec., 1918.—This report covers data gained by the method of questionnaire and by direct investigation of 111 establishments employing 71,595 workers. While it is true that much of the material assembled is of a type obtainable through schedules of inquiry, it is equally true that reliance cannot be placed upon such methods of research for final demonstration of the extremely important facts presented in this report. Unfortunately, there is no separation of data gathered by the questionnaire and data gathered by field investigations and, furthermore, the identity and scientific standing of the field investigators employed is not given. These are omissions not in accord with the most exact type of scientific inquiry.

The hours of work in the wool industry are very uniform. They vary between fifty and sixty hours per week, but 68.4 per cent. of the employees work fifty-four hours; 18.2 per cent. fifty-five hours; 5 per cent. fifty-six hours; and a little over 3 per cent. more than fifty-six hours. Two and seven-tenths per cent. work fifty hours and 2.5 per cent. fifty-three hours.

The most interesting records are found on pages 32-43 of the report. The figures given indicate that under apparently comparable conditions, or as nearly comparable as can be provided in this complex industry, reduction of hours from in the neighborhood of fifty-seven to fifty-four hours per week practically invariably results in a decrease in output. In the entire group only six establishments report a gain in production as a result of shortening hours, and seven report a maintenance of production on the shorter working week. These results have not occurred in the larger and more modern mills upon which the industry depends, but in the smaller and older establishments. It is a matter for regret that the report does not cover in the greatest detail all the conditions surrounding work in a representative mill which has lost in production and in one which has gained, since a more vivid comparison of the data on output could thus be made.

The experience gained seems to justify the conclusion that the reduction to a fifty-four-hour schedule in wool manufacturing, while involving a net loss in output, has not resulted in a heavy burden upon production. The fact that wool manufacturing is largely a machine industry in which the speed of the worker is, in the main, imposed by the rate of the machine, is a factor rendering it very difficult to keep output high with any reduction of hours. This fact, too, renders it impossible to judge from output statistics as to harmful fatigue in workers. Where the rate of the machine regulates output it is clear that shorter hours must spell decreased production. In such instances fatigue must be judged from sickness reports, absenteeism, accident incidence and other correlative sources of information. The fact that there is a relatively high accident incidence in wool working is perhaps of importance in this relation.

When the reader reaches the direct discussion of health in this report on wool manufacturing, he is much disappointed by the character and sparsity of the data presented.

"Of fifty-seven establishments definitely reporting on health conditions, fifty stated that shortening of hours of work had no significant effect; four reported a decided improvement, while three others said that the effect had been good."

These statements are not substantiated by medical facts, but by opinions from union officials and mill representatives. The dust, heat, humidity and vitiated air hazards are mentioned but no exact data are given as to their extent. The most important conclusions relative to health relate to tuberculosis and are taken from the mortality statistics of the census of 1909. These figures bring out a high tuberculosis incidence in wool workers. Unfortunately they are not amplified by any direct medical examinations at the present time. While such examinations could have no statistical relation to reduction of hours, because of lack of directly comparative figures, they would contribute toward establishing the real nature of the steady physical strain of wool manufacturing as it is now carried on. Fortunately we are assured that many wool establishments are now making careful observations of sickness among their employees and a future

report will doubtless furnish accurate information as to present-day conditions.

The relations of anthrax and industrial accidents to the health of wool workers are disposed of briefly, since neither type of hazard is of distinctive importance, though as has been said, accident incidence is rather high.

Viewed as a whole the report is suggestive, and it is to be hoped that the National Industrial Conference Board will consider the work in this light and will make use of the unparalleled facilities at their command for a thorough health survey of wool manufacturing.—David L. Edsall and Cecil K. Drinker.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

A Routine Method of Mental Examinations for Naval Recruits. *L. E. Bisch.* U. S. Nav. Med. Bull., April, 1919, 13, No. 2, 198-228.—The author has devised a method of rapidly classifying recruits, preliminary to more intensive study of those needing it. He insists that each psychological examination must be individual. Tests which do not depend on school knowledge must be stressed. He uses the "Knox Cube," "Digits Backward," and "Healy 'A' Form Board" tests. He has modified the former methods of scoring these tests. He also gives charts showing the results in over 3000 cases.—C. C. Lund.

INDUSTRIAL HEALTH SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

A Program of Health as Applied by the American Pulley Company. *W. A. Sawyer.* Mod. Med., May, 1919, 1, No. 1, 39-43.—The plan of this company has involved preliminary physical examination, periodical physical examination, dental care, rest, recreation and dispensary service. The utility of this extensive program is strongly advocated. Comparatively few details as to its manner of conduction are given.—C. K. Drinker.

Industrial Health Protection at the Western Electric Company. *Margaret J. Robinson.* Mod. Hosp., May, 1919, 12, No. 5, 378-379.—A brief general statement of the health administration in the plant of the Western Electric Company, Hawthorne, Ill.

The most valuable feature of the article is the plan of the medical supervision buildings of the company.—Katherine R. Drinker.

INDUSTRIAL HEALTH LEGISLATION AND COURT DECISIONS: MALINGERING

New Regulations Governing Bakeries. Bull. W. Va. State Dept. of Health, April, 1919 6, No. 2, 44.—A copy of the regulations concerning employment, location and cleanliness in bakeries.—Hazel Andrews.

WORKMEN'S COMPENSATION AND INSURANCE

Lacks in Workmen's Compensation. *R. Meeker.* U. S. Bur. Labor Statis., Month. Labor Rev., Feb., 1919, 8 No. 2, 1-11.—The material in this discussion was presented in a paper before the American Association for Labor Legislation, December, 1918. Mr. Meeker calls attention to failures in compensation legislation at the present time: (1) Compensation laws are wholly lacking in ten states and in the District of Columbia; (2) In most instances, existing compensation laws fail to affect certain classes of workers, such as railroad employees and farm and domestic help; (3) They do not make satisfactory provision for medical care, which is of the first importance in that it determines how soon the worker shall become self-supporting again. (4) With few or no exceptions, compensation is insufficient to protect the worker from want. To establish compensation on a firm basis states should eventually organize exclusive public insurance for all employees in the state.—C. H. Paull.

Group Insurance for the Industrial Worker. *E. E. Rice.* Ind. Management, March 1919, 57, No. 3, 234-236.—Group insurance, according to the writer, should cover more particularly sickness and injuries which are not included in the provisions of state compensation. Payment of claims should be automatic so that workers may not be discouraged by delays. Sickness and accident benefits are usually based upon a per cent. of the wage of the individual or upon the amount which he optionally contributes toward insurance. In most cases the industry furnishes a portion of the cost of insurance or assumes the entire risk. Life insurance on the group plan basis is relatively

inexpensive. Group insurance could well be extended to provide old age pensions. The effect of group insurance upon the worker is considered very satisfactory in that it relieves him of the fear of the consequences of illness and assists him in providing medical care when he is sick that will return him to his work in the shortest possible time.—C. H. Paull.

Health and Old Age Insurance in Ohio. *J. A. Lapp.* Am. Labor Legis. Rev., March 1919, 9, No. 1, 47-58.—The writer, who has been directing the investigations of the Ohio Health and Old Age Insurance Commission points out statistically the need for insurance in that state. He believes that an insurance scheme such as that proposed should be accompanied by preventive measures as far as the state can furnish them. These measures should include prenatal care, and should continue health supervision during the growing period of the child. Provision should also be made for the adult through the study and prevention of contagious diseases, adequate medical care, etc. However, in spite of all these precautions, illness cannot be completely eliminated and consequently health insurance must be provided as a part of the return which the state owes the individual for his participation in productive activities. By the same course of reasoning old age insurance should also be provided. Emphasis is placed upon the necessity for a thorough rehabilitation policy which will place the worker back in his regular employment, and thereby save him to society and allow him to retain his full measure of independence. Some of the arguments against health and old age insurance are answered in the last of this discussion.—C. H. Paull.

Lest We Forget. A Study of Health Insurance in Relation to the History of the Two Countries Where It Has Found Most Favor. *A. F. Downing.* Boston Med. and Surg. Jour., April 17, 1919, 180, No. 16, 433-444.—This paper is an essay on the subject of health insurance.—G. B. Minot.

Next Step in Social Insurance in the United States. *S. M. Lindsey.* U. S. Bur. Labor Statis., Month. Labor Rev., Feb., 1919, 8, No. 2, 28-34.—Mr. Lindsey points out that we must continue to develop a policy of social insurance which will be larger in scope than our war risk insurance scheme.—C. H. Paull.

The Next Steps in Social Insurance in the United States. *S. M. Lindsey.* Am. Labor Legis. Rev., March, 1919, 9, No. 1, 107-114.—With our experience in war risk insurance as a logical point of departure, the writer advocates: (1) That the most liberal provision for the conversion of war risk insurance to permanent insurance be made; (2) that this insurance be extended to all employees of the government; (3) that health insurance be developed by governmental agencies until it is available to all citizens as an essential element of health service; (4) that states administer mutual health, accident, invalidity, and old age insurance for all industrial workers and that such insurance shall be compulsory in the cases of workers unable to provide protection for themselves in other ways. The writer points out that such a policy as outlined by him would not take the place of private insurance agencies, but would still leave a large field for them to develop.—C. H. Paull.

Conflict of Compensation Acts. *C. C. Sherlock.* Machinery, Feb., 1919, 25, No. 6, 524-525.—This article draws the attention of employers who do business in several states to the conflict of Compensation Acts. The author has found that the following general principles apply:

1. The law of the place of injury governs as to the amount of compensation that may be recovered.
2. The compensation acts have no extra-territorial effect as a general rule.
3. The *lex fori* governs as to procedure and manner of recovery.
4. Compensation cannot be recovered in a state which does not have the necessary machinery to enforce the right.—R. M. Thomson.

Comparison of Experience Under Workmen's Compensation and Employers' Liability Systems. *C. Hookstadt.* U. S. Bur. Labor Statis., Month. Labor Rev., March, 1919, 8, No. 3, 230-248.—The purpose of this discussion is to bring together existing data relative to the operation of workmen's compensation and employers' liability systems. The writer presents tables and other statistical material which tend to show that employers' liability is wasteful and does not do the employee justice in that he often fails to collect for an injury or else is forced to pay legal fees averaging about 25 per cent. of the money granted. Compensation, on the other hand, if properly established would eliminate the element of chance both in the case of the employer and of the employee.—C. H. Paull.

Liability of Employer for Hospital, Surgical and Medical Aid. *C. C. Sherlock.* Machinery, May, 1919, 25, No. 9, 835-836.—This article is a review of the amount of the aid an employer is obliged to furnish under the workmen's compensation acts. A great deal of uncertainty exists among employers as to just what they are required to do in certain instances. If a workman is injured while performing his work as an employee he is entitled to (1) immediate medical attention, (2) hospital care if necessary, (3) surgical attention. Other points of discussion in this article are: The right of selecting a physician; Amount for which employer is liable; Length of time for which employer is liable; Extent of medical aid liabilities; and Liabilities in the case of an operation.—R. M. Thomson.

Who Shall Bear the Extraordinary Compensation Cost of the Total Disability Caused by Successive Injuries? *R. M. Little.* Amer. Labor Legis. Rev., March, 1919, 9, No. 1, 141-149.—This discussion points out that both in the case of the war and in the case of the industrial cripple there is danger that employers will hesitate to take the risk of permanent disability and consequent compensation payments as provided in many states. The government, it is pointed out, should assume the extraordinary compensation

cost for recurring injuries to soldiers after their return to civil life. In a similar manner the states could follow the example of Ohio and New York and provide means for relieving the employer of the whole responsibility for total disability in case of second injuries. If the handicapped worker could be made no greater a risk than the normal worker, he should be an asset in many forms of employment since his very handicap would tend to make him a more stable and thoughtful worker.—C. H. Paull.

Shall the Ambitious Cripple Suffer Loss of Workmen's Compensation Benefits? *C. Hookstadt.* Am. Labor Legis. Rev., March, 1919, 9, No. 1, 137-140.—The writer points out that the greatest fault in state compensation laws at present is the inadequacy of medical service and of compensation provided disabled men. Through lack of careful investigation compensation has, in some cases, not been based upon the severity of the handicap. Compensation benefits, furthermore, have in general failed to take into account such factors as the age and occupation of the employee. It is proposed that these factors be given consideration and that all schemes of compensation carefully avoid provisions whereby the worker will be penalized for returning to work as soon as possible.—C. H. Paull.

REHABILITATION OF DISABLED EMPLOYEES

Training Disabled Men for Self-Support. *D. C. McMurtrie.* Machinery, March, 1919, 25, No. 7, 649-650.—This article outlines briefly three means of reducing the cost of disability: First, accident prevention; second, medical attention to minimize disability; third, salvage of the remaining abilities of the worker through rehabilitation. The first of these has received wide attention from employers and has been encouraged financially by casualty insurance companies and state funds. The value of the other two means, however, has not as yet been appreciated. Their energetic application would effect a tremendous saving to industry. Unlimited adequate medical attention should be an axiom of casualty practice, and should be demanded by both employer and workman. The aim should be to have the employee return to his job, fully recovered, in the shortest possible time. It is well to develop a science of dealing with cripples, but the ideal is to have fewer cripples.

The third method of lessening the cost of disability is rehabilitation or re-education for self-support. Few jobs require all the physical faculties, and in the present-day variety of industrial processes it is possible to find a job in which a man with a given type of disability can function with 100 per cent. efficiency. The process of re-education can be provided best in a special school for crippled men. In short, the first effect should be to prevent injury, the second to minimize its permanent effects, the third—when disability has ensued—to offset its economic consequences. The execution of this program is not only sound, humanitarian practice—it is good business as well.—R. M. Thomson.

Rehabilitation Problems. *G. M. Price.* Survey March 29, 1919, 921-922.—A brief statement of some of the points emphasized in the recent international congress of rehabilitation workers held in this country.—C. H. Paull.

Rehabilitation of Industrial Cripples in Massachusetts. *F. O. Robertson.* Am. Labor Legis. Rev., March, 1919, 9, No. 1, 126-129.—A statement of some of the policies of the Vocational Training Division of the Massachusetts Industrial Accident Board, emphasizing the importance of treating cases individually.—C. H. Paull.

Industrial Experience of Handicapped Workmen in Wisconsin. *G. P. Hambrecht.* Am. Labor Legis. Rev., March, 1919, 9, No. 1, 117-125.—An account of the policy of the handicapped division of the Milwaukee State Employment Office, giving list of workers placed and classified according to handicaps, and showing type of work secured.—C. H. Paull.

Employment Opportunities for Rehabilitated Men in Pennsylvania. *H. A. Mackey.* Am. Labor Legis. Rev., March, 1919, 9, No. 1, 130-133.—An argument in favor of the social need for offering opportunities of rehabilitation to all, regardless of the cause of the disability.—C. H. Paull.

An After-Care Clinic in Oregon. *P. H. Douglas.* Am. Labor Legis. Rev., March, 1919, 9, No. 1, 134-136.—An account of the work undertaken in the course organized at Reed College for the training of women as aides in physio-therapy, with suggestions for the care of disabled men.—C. H. Paull.

Possibilities of an Industrial Cripple Sustaining a Second Injury. *C. Hookstadt.* U. S. Bur. Labor Statis., Month. Labor Rev., March, 1919, 8, No. 3, 79-88.—Through a study of statistical material gathered in Wisconsin the writer concludes that the danger of the industrial cripple being injured a second time is comparatively slight. By the use of the accident frequency rate for the state, he points out that the number of second major disabilities would probably be about one a year. Because of added care in placing disabled workers and because they have fewer members to expose, he suggests that the accident frequency rate would be no greater in their case than for normal workers. An investigation recently made in California tends to bear out these conclusions. The small amount added through second major injuries to compensation cost to the state is consequently negligible. In order that individual employers shall not be overburdened with compensation payments, it is desirable that the state make provision for the payment of a portion of the second disability cost, as is done in Ohio and New York.—C. H. Paull.

ABSTRACT *of the* LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME I AUGUST, 1919 NUMBER 4

CONTENTS

GENERAL

GREAT BRITAIN, ANN. REP. CHIEF INSPECT. FACTORIES AND WORKSHOPS FOR 1915. Parliamentary Paper, Cd. 8276, 1916, pp. 1-12.—This report deals only with duties which have arisen in connection with the war. In conjunction with the Board of Trade, the Factory Inspectors aided in the movement to supplant men with women in numerous industries. Trade conferences were instituted to consider measures necessary to free as many men as possible for the army and to determine how far men so released could be replaced by other classes of labor. The necessary reorganization of labor in most cases involved temporary suspension of recognized trade rules and customs, and the points to be settled, therefore, were chiefly those relating to the terms and conditions under which such suspension should take place. The operatives asked for guarantees that those who left for the army should have their places kept open for them, that suspension of rules should be regarded as a war emergency only, that there should be a return to former conditions at the end of the war, and that there should be a fair settlement of the wage question affecting employment of women, or rather labor called in to replace men.

Owing to the exigencies created by the war there arose the necessity for granting to munitions plants exemptions from the restrictions of the Factory Acts. These exemptions took the form of General and Special Orders. The General Orders established limits for an industry as a whole, and Special Orders were issued to individual plants to cover particular needs. The General Order for engineering works manufacturing munitions (before modification according

to the recommendations of the Health of Munitions Workers Committee) provides: (1) Overtime, with a limit of five hours per week for women, boys between 14 and 16 years, and girls between 16 and 18 years; and of seven and one-half hours for boys over 16 years and also (in a few cases of special urgency) for women; (2) Day and night shifts for women and boys over 16 years old and in certain cases for boys over 14 years; (3) Eight-hour shifts for women, girls over 16 and boys over 14 years. Sunday labor was found to prove more and more unsatisfactory to all concerned. The aim has been to discourage long periods of overtime work, and to encourage introduction, where possible, of two and three shifts of workers in continuous operations.

The Factory Inspectors had not as yet found that the strain of long hours had caused any serious breakdown among the workers, save in the case of foremen, managers and some of the older workers. The foremen and managers were usually unable to take days off to get relief from accumulated fatigue. In certain cotton mills periodical medical examinations of workers were made a condition for continuance of overtime and power was given to the examining surgeon by consent, to suspend anyone showing undue signs of fatigue.

The effect of increased hours on production is not very clear. The general opinion is that reasonable overtime does yield increased output, though the increase is not in full proportion to the extra hours worked.

The increase in machinery, the longer hours, and the introduction of female labor have raised new problems in safety, ventilation and sanitation which on the whole have been met satisfactorily. A most important effect of the war on factory environment is the great advance in welfare work, in the provision of canteens and mess-room accommodations and in arrangements for dealing with cases of sickness and injury. The introduction of female supervisors over women workers is regarded as highly satisfactory.—Barnett Cohen.

Disabling Sickness Among the Population of Seven Cotton-Mill Villages of South Carolina in Relation to Family Income. *Edgar Sydenstricker, G. A. Wheeler* and *Joseph Goldberger*. U. S. Pub. Health Ser., Pub. Health Rep. Nov. 22, 1918, 33, No. 47, 2038-2051.—Illness of relatively long duration, occurring in families of small incomes, even when not millworkers, shows low economic status to be a more important factor in sickness rate than employment in the mills.—Rhea Fuller.

Third Biennial Report, 1917-1918, Bureau of Labor, State of Arkansas.—Child labor employment certificates have been issued in compliance with the rules of the Children's Division of the U. S. Department of Labor. The policy has been to correct violations rather than to punish violators. During the vacation months of 1918, due to the pressure of high cost of living and of epidemics, children between 10 and 14 were permitted to work. This permission held only for three months.

The Minimum Wage and Maximum Hour Law, which applies to all women workers except telephone employees, has been found to be one of the best protective measures.

The boiler inspection department has prevented several boiler explosions.

Statistics are given, showing the number of accidents in the lumber industry. The number of accidents has increased in the coal industry, showing that more drastic laws are needed.—Hazel Andrews.

Report of the Industrial Board of the State of Indiana for the Year Ending Sept. 30, 1918—Detailed reports from the department of boiler inspection, factories, buildings and workshops are given. The work with women and children during the war is reported.

The report on mines and mining is extended, including a large amount of recommended legislation. A statistical report of accidents and fatalities in all industries is appended, which classifies the accidents according to industry, to the cause of injury, and to the nature of the injury.—Hazel Andrews.

Third Biennial Report, 1917-1918, Department of Labor and Industry, State of Montana.—The Compensation Law is discussed and certain changes recommended. The Child Labor Law of Montana is shown to be one of the best.

A table is given which is a comparative record of deaths from tuberculosis in Silver Bow County from August, 1907, to August 31, 1918.—Hazel Andrews.

Eleventh Biennial Report, 1917-1918, State of Washington, Bureau of Labor.—The labor situation has improved, both as to wages and living conditions. "Eating, sleeping and hospital accommodations have transformed many (logging) camps and a feeling of self-respect has been aroused."

Greater emphasis has been placed on the educational side of the "Safety First" problem. The Industrial Welfare Commission has established minimum wages in many industries and has issued orders for proper sanitary conditions. The same commission has extended the regulations of the federal act as to hours of minors, and has established legal wages for both boys and girls under 18. The eight-hour law for women has been effectively enforced, as is shown by the report on the cases. An investigation of women replacing men in railway and factory occupations has shown that, in general, adequate provision is made for the comfort of the women.—Hazel Andrews.

Fourteenth Biennial Report, 1917-1918, Bureau of Labor of West Virginia.—The increase in industrial establishments in West Virginia has necessitated the continuous services of two factory inspectors, and even this is not sufficient. It is found that the legislation regarding women in industry is inadequate and that the present Child Labor Law needs revision. Eighty-three factories were found employing children in violation of the law and these children were in-

structed to secure permits before they could continue working.

During 1917, 67,300 employees were inspected and 1,088 orders issued. During 1918, the number of employees was 82,719, and the number of orders, 637.—Hazel Andrews.

First Biennial Report, 1917-1918, Commissioner of Labor Statistics, State of Wyoming. —The report states that the "conditions of labor during the past two years have been very satisfactory and encouraging." Sanitary conditions have improved in all plants.

The fifty-two-hour law for women seems to be working smoothly with but few complaints from employers. Statistics on women's wages are given.—Hazel Andrews.

Guide Posts on the Road to Health. *Sara L. Halliday.* Municipal Reference Library, City of New York, April 30, 1919, Special Report No. 3, 7 pp.—A list of popular books upon health and hygiene.—T. J. Putnam.

Prevention of Disease and Care of the Sick. *W. G. Stimpson* and *M. H. Foster.* U. S. Pub. Health Ser., Miscellaneous Publication No. 17, 2nd. edition. Paper, 318 pp., with illustrations. Washington: Government Printing Office, 1919. —This excellent manual is written for the intelligent layman. The description it gives of the commoner diseases and their treatment is as full as it is profitable to make them, without going into technicalities. It contains sections on the Sanitation of Buildings, Transmission of Disease by Insects, Sanitation of Vessels, Camp Sanitation, Personal Hygiene, Childbirth, Care of the Baby, Care of the Sick, and First Aid to the Injured.

Especially commendable are the articles on lighting, heating, and ventilation, on modern types of privies, and on the destruction of insects. The section dealing with specific diseases gives a clear, easily understood account of each, and recommends in each case a simple, conservative treatment. It may be questioned, however, whether a layman would be able easily to make a differential diagnosis from the accounts given; an index of symptoms might be a valuable addition. The division given over to First Aid to the Injured is well arranged and much more complete than most first-aid manuals, going into such matters as the newer methods of sterilization of wounds, and the technique of suturing, ligaturing, applying plaster casts, etc.

This book should be of great value on farms, ships, and under other conditions where professional medical advice is not available.—T. J. Putnam.

National Problems of Mental Health. *H. Y. Delgado.* Revista de psiquiatria, y disciplinas conexas, April, 1919, 1, No. 4, 203-211.—Emphasizes the need now and the favorable opportunity, with the momentum of interest due to the war, to organize efforts to improve mental efficiency and health. There is need of more psychological work in medicine, and attention to the problems of alienation, delinquency, and mental weakness, with reference to public health.—G. E. Partridge.

Health and Occupation. Jour. Am. Med. Assn., April 26, 1919, 72, No. 17, 1240.—In a letter to the (London) *Times*, Prof. J. S. Haldane corrects the wide-spread mistake as to the dangers to life and health in coal mining as compared with other occupations, and gives a table compiled from the last of the reports on occupational mortality issued by the registrar-general, showing that the mortality in coal mining is below the average for all occupied males of the same age-group. Among coal miners the death rate from accident is about double that in average occupations. Even so, coal mining is a relatively safe occupation. It has become so to a steadily increasing extent during the last forty years. Apart from accidents, it is now one of the most healthful occupations, though it could be made still more healthful, and considerably more safe.—T. J. Putnam.

Twenty Suggestions to Industrial Physicians and Surgeons. *C. D. Selby.* Mod. Hosp., June, 1919, 12, No. 6, 455-458.—This article, in its original form, appeared in *Modern Medicine*, May, 1919, 1, No. 1, 34-38, and is abstracted in the Journal of Industrial Hygiene, July, 1919, 1, No. 3, 35.—K. R. Drinker.

The Problem of Drug-Addiction. *Clifford Griffin* Bull. R. I. State Board of Health, Feb., 1919, 5, No. 1, 22-29.—By a state law passed in April, 1919 (Gen. Laws, Ch. 1674) the care of drug addicts was vested in the state Board of Health. The plan of treatment adopted was one of surveillance, a prescription being given to each addict daily for the day's amount of the drug, which amount was gradually but slowly diminished. One-third of the addicts had no useful occupation. In about one-half the cases, the environment was bad. A fifth of them had not had a grammar school education. The habit was acquired by association in 98 per cent. of the cases. Many of the addicts have been improved, but few have been cured. The aim of treatment should usually be the control of the amount taken, the patient being given finally no more than 5 or 6 grains daily; he is then usually enabled to work and is not at the mercy of peddlers of the drug. Isolation in an institution is practically essential to a cure; an amendment to the present law to permit this is recommended.—T. J. Putnam.

The New Science of Industrial Physiology. *Frederic S. Lee.* U. S. Pub. Health Ser., Pub. Health Rep., April 11, 1919, 34, No. 15, 723-728. —The relation of the body of the worker to industry has been called "Industrial Physiology." Its two objects are to learn how to secure the largest output and maintain maximum bodily health, and to establish these conditions in the factories. Scientific investigations are being carried on in factories in which the conditions of the workers are varied for experimental purposes, while accurate measurements of output are made. Investigations have shown the following: Fatigue reduces output during successive hours. A shorter working day increases hourly rate of production. Rest periods during a long working day increase output. Overtime and heat impair output also. Night work falls very low in output in

the early morning hours. Women are found to be capable of doing many kinds of industrial work which have heretofore been performed only by men. Accidents, labor turnover, and food and efficiency are important factors. Scientific motion study enables unnecessary motions to be eliminated.

England, France and the United States have made valuable investigations on the above topics. Leading universities in the above countries are also taking up the problem of the human factor in industry.—E. H. Reeves.

THE PSYCHO-PHYSIOLOGICAL FACTOR IN INDUSTRIAL WORK. *I. Ioteyko.* Bulletin de L'Institut général psychologique, July-Dec., 1918, 8, No. 46, 166-185.—Most investigators who have studied industrial efficiency have left out the interests of the human factor. Man has been considered too much as a physical motor, and too little as a psycho-physiological apparatus. The problem, instead of being simple, is exceedingly complex, and must be treated analytically. The economic functioning of the organism must be examined from many points of view. Fatigue and expenditure of energy must be measured; the influence of general intelligence on productivity, proper selection of workers, special aptitudes, must be studied. Minimum expenditure of energy must be attained by establishing the conditions that make it possible.

Among already discovered facts and principles are these: The organism can adopt a manner of work that is more or less economical. There is no fixed relation between work and fatigue; more or less energy can be produced during the day according to need. There is a relation between general intelligence and work. Waxweiler's studies show an hierarchy of occupations according to the precision of attention required. There is a relation between general education and capacity for work. Imbert has shown that even in mechanical occupations capacity depends more upon the mental than upon the physical qualities of the man.

The most undeveloped phase of the problem of the psychology of production is its individualistic aspect. Taylor, for example, has taken into account only the general psychology of productivity. He has measured the output of the worker, but not the fatigue, etc., of the worker. The cost in energy in producing a given result must be considered. The intensity of effort varies greatly when the work is prolonged beyond a certain point, provided the quality and quantity of output must be maintained. These psycho-physiological facts must be introduced into questions of wages. The coefficient of increase must be determined experimentally in each occupation. There are many such problems in the field of energetics, as applied to industry. Economic science must enlarge its sphere and become individual, but of course without ceasing to be social.—G. E. Partridge.

PRACTICAL APPLICATIONS OF PSYCHOLOGY AS DEVELOPED BY THE WAR. *G. Stanley Hall* Pedagogical Seminary, March, 1919, 26, No. 1, 76-89. —Nine-tenths of the energy of the world is absorbed by industry. After the war our great task is to rehumanize industry, to break down the disastrous partition that has grown up between brain-work and hand-work. We must learn how to put both head and heart into industry. The efficiency of the country in war has been vastly increased by what may be called vocational guidance. We must apply the same principles in fitting every man to his work. Differences among individuals in various abilities are very great, and a knowledge of these and of methods of measuring them must be employed. Differences in intelligence are important, but there are also profound differences in type of organization, which are even deeper than differences in race. Psychology must help to create a new spirit in work, which will be far-reaching in its effects upon efficiency, health, and morality.—G. E. Partridge.

EDUCATIONAL DIFFERENCES AMONG TRADESMEN. *H. A. Toops* and *R. Pinter.* Jour. Applied Psychology, March, 1919, 3, No. 1, 33-49.—This is a study of about 1,000 men of various trades, classified as apprentice, journeyman and expert; and of the relation of the education of tradesmen to that of the members of professions and of laborers. It was found that boys having education only up to the third or fourth grade are practically condemned to a life of labor. From a third or fourth grade education, but with less than a seventh, the chances of becoming a journeyman tradesman only are greater than the chances of becoming an expert tradesman. With better than a seventh grade education the chances are greatly in favor of eventually becoming an expert tradesman.—G. E. Partridge.

LAUNCHING PART-TIME CO-OPERATIVE EDUCATION ON A LARGE SCALE. *F. M Leavitt.* Manual Training Magazine, April, 1919, 20, No. 8, 267-275.—The Pittsburgh plan is described and discussed. Several of the large department stores have entered into a co-operative arrangement with the Carnegie Institute of Technology and the public schools for the study of problems relating to the training of department store employees. The owners of the stores have contributed jointly the sum of $32,000 a year for the work. A first-year high school course has been worked out. The writer believes the plan a step in advance in the direction of reaching the "privates" in a numerous branch of the industrial army.—G. E. Partridge.

EVENING AND PART-TIME SCHOOLS IN THE TEXTILE INDUSTRY OF THE SOUTHERN STATES. Federal Board for Vocational Education, April, 1919, Bulletin No. 30, Trade and Industrial Series No. 5, 106 pp.—The Federal Vocational Education Law (Smith-Hughes Act) provides funds out of the national treasury for co-operation with the several states in promoting vocational training. The conditions under which these funds are available are briefly as follows:

(1) The classes must be under public supervision or control.

(2) The controlling purpose of the instruction must be further to fit employees for useful employment.

(3) The instruction must be less than college grade.

(4) The minimum age for pupils shall be fourteen years for part-time instruction, and sixteen years for evening instruction.

(5) Federal money obtained through state boards shall be used only for the payment of salaries of teachers.

(6) The amount of federal money expended must be equalled by the amount of public funds from the state or local community.

Forms of application and records are given for such schools in the cotton industries, and suggestions are made as to the organization, personnel, hours, and subjects of instruction.—T. J. Putnam.

INDUSTRIAL ARTS IN RECONSTRUCTION. *W. T. Bawden* School and Society, March 8, 1919, 9, No. 219, 279-284.—The author recommends distinct changes in education: more exact preparation in high schools for occupations, part-time division between schooling and employment, lengthening of school sessions, elective vocational courses, more required industrial arts in the high schools, more handwork in the grades.—G. E. Partridge.

CONTINUATION SCHOOLS IN INDUSTRIAL AREAS. Report of a paper by *Principal Loughborough*, England. Jour. Education, April, 1919, 51, No 597, p. 228.—It is essential that in these areas a fair proportion of time should be given to vocational studies. A certain amount of physical culture would be desirable, and also broad studies in the elements of citizenship.—G. E. Partridge.

REPORT OF THE COMMITTEE ON VOCATIONAL SUPERVISION. *Ella A. Moore.* Jour. Nat. Education Assn., Jan., 1919, 3, No. 5, 335-337.—In the city of New York about 50,000 children apply each year to begin at 14 the long task of making a living. Similar conditions prevail elsewhere. The work of the committee is to cope with this situation, and to provide vocational guidance and other aid.—G. E. Partridge.

AFTER-SCHOOL CARE OF THE FEEBLE-MINDED. *C. Steinbach.* Jour. Nat. Education Assn., Feb., 1919, 3, No. 8, 399-400.—This article emphasizes the need of definite attention to the more or less mentally deficient, so that they will not be left to adjust themselves to life unaided. The average normal child is competent at 15. The sub-normal must be educated and protected for a longer period.—G. E. Partridge.

PROBLEMS OF INDUSTRIAL READJUSTMENT IN THE UNITED STATES. Nat. Ind. Conference Board Pub., Feb., 1919, Research Report No. 15, 58 pp. —A critical but optimistic review of the available statistics bearing on reconstruction.—T. J. Putnam.

SECOND REPORT OF THE INDUSTRIAL COMMISSION OF COLORADO Dec. 1, 1917, to Dec. 1, 1918. —A report on the administration of the Workmen's Compensation Act, the Industrial Relations Act, the State Compensation Insurance Fund, and the Colorado Minimum Wage Law.—T. J. Putnam.

POSITIVE CONTRIBUTIONS TO SCIENTIFIC MANAGEMENT. *Henry H. Farquhar.* Quart. Jour. Econ., May, 1919, 33, No. 3, 466-504.—This article is a rather abstract discussion of "some of the accomplishments of the science of management in the field of industry during the thirty years or less of its development." There is no statistical material given in support of its statements. It is a purely descriptive article, written from the viewpoint of the economist.

The relation of the length of the working day to output as recognized by Taylor and other advocates of scientific management is briefly described on page 492. "Conditions of Work as Related to the Health and Well-Being of the Worker" is the heading of a three-page section. According to the author, most measures conducive to the well-being of the worker have always been associated with plants which have adopted the Taylor system of management. One finds in such plants "satisfactory conditions as regards accidents, health and sanitation, the speedy and impartial adjustment of grievances, and comfortable working conditions generally. . . . Mutual benefit societies and insurance and retirement funds which were initiated by Mr. Taylor very early in his work . . . are very characteristic of plants following his lead. . . . It is significant that the first 'fatigue study' ever conducted in a really scientific manner, so far as the writer's records show, was performed over thirty years ago by Mr. Taylor as part of his determination of a proper day's work." Wages, labor turnover, industrial democracy, selection, fitting, and training of employees, are other subjects discussed along with the above, under the heading of "The Human Factor."—Linda James.

LABOR ADMINISTRATION IN THE SHIPBUILDING INDUSTRY DURING WAR TIME. *P. H. Douglas* and *F. E. Wolfe.* Jour. Pol. Econ., March, 1919, 27, No. 3, 145-188.—The greater part of this article is a history of the machinery developed to so adjust industrial relations in the shipyards controlled by the U. S. Fleet Corporation that maximum output could be obtained. On pages 180-181, is a description of that part of the corporation which undertook to improve transportation facilities and housing. On page 182, the activities of the "Health and Sanitation Section" established in January, 1918, are mentioned. "The work was a duplication to some extent of that for which the U. S. Public Health Service is fitted, until, by an executive order of the President on July 1, it was made a co-ordinate part of the Public Health Service." The "Safety Engineering Branch" is described on page 183. "The object of all activity has been the prevention of accidents, not merely as a welfare measure, but as a direct contribution to production." In concluding the article, the authors promise a subsequent one which "will treat the functioning of the organizations upon the problems faced in shipbuilding during the war."—Linda James.

DUST HAZARDS AND THEIR EFFECTS

Preliminary Report of the Committee on Mortality From Tuberculosis in Dusty Trades. U. S. Dept. Labor, Working Conditions Service. Washington: Government Printing Office, 1919, 27 pp.—This report is a description of the excellent organization and methods of the committee. It does not attempt any conclusions upon the subject to be investigated.—T. J. Putnam.

Standards for Measuring the Efficiency of Exhaust Systems in Polishing Shops. *C.-E. A. Winslow*, *L. Greenburg* and *H. C. Angermyer*. U. S. Pub. Health Service, Pub. Health Rep., Mar. 7, 1919, 34, No. 10, 427-449.—Injurious dusts are considered in regard to size and shape. A review and discussion of the dust codes of the few states having these regulations is given. An experiment demonstrates the error in basing a standard on the U-tube reading, as an inlet gives the same static reading restricted as it does with the opening unobstructed. The most satisfactory determination would be in regard to the condition of the air as inhaled by the worker.

The Palmer water spray apparatus was used in the tests by the authors and the manipulation is given in detail from the taking of the sample to the counting and weighing of the dust particles.

Several grinding and polishing shops were studied. Air velocities and U-tube readings were taken. Plans are shown of the exhaust layouts of two of the shops studied.

From the above experiments the following standards are suggested:

Suction head (average) 3 inches, at no point below 2 inches.

Air velocity at intake of exhaust pipe, 2500 feet per minute; minimum 1500 feet per minute.

Five types of exhaust hood were studied:

1. Underneath exhaust—highly efficient.
2. Overhead exhaust.
3. Special curved hood, flared sides.
4. Galvanized steel hood over belt polishers—satisfactory.
5. Ordinary galvanized steel hood—design and upkeep usually poor.

Results show that different processes will have to be given detailed study, as individual and separate standards will necessarily have to be used.—E. H. Reeves.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Two Cases of Almost Complete Phosphorus Necrosis of the Jaws. *M. Pinel.* Bulletin médical, Sept. 14, 1918, No. 34, 375-376.—The two patients were both employed in the same fuse factory. The necrosis was in each case extensive, with sinus and sequestrum formation. The sequestra were removed surgically, and both patients recovered.

The author notes that, while all surgeons are agreed that operation is essential in such cases, they differ in regard to the time of election. Some believe that the necrosis is a manifestation of a general intoxication, and that operation before the separation of the sequestrum, unless very radical, does not prevent the extension of the process and may even delay healing. The German school, on the other hand, believes that the general condition is improved by attending to the local process early. The cases in which the early operation is indicated are those in which the patient cannot stand the strain of his disease. The operation should then be a resection in most cases.—T. J. Putnam.

Clinical Study of Frequency of Lead, Turpentine and Benzine Poisoning in 402 Painters. Editorial Review of a study made under the direction of *Louis I. Harris*, Director, Bureau of Preventable Disease, New York City, Department of Health, and published in the Archives of Internal Medicine, August, 1918, pp. 129-156. U. S. Bur. Labor Statis., Month. Labor Rev., March, 1919, 8, No. 3, 226-229.—This article gives the résumé of a study of 402 painters doing interior painting and decorating. One hundred and sixty-three, or 40 per cent., showed active lead poisoning. Seventy-two of the 163 active cases also had lead in the urine, while thirty-five had lead in the urine without clinical signs. Forty-eight and seven-tenths per cent. gave evidence of active or latent lead poisoning. Few reach the age of 50 years as active members of this trade "Alcoholic indulgence does not appear to be a marked predisposing factor toward lead poisoning." Remedies suggested are public health measures and personal hygiene, washing of hands, face, and mouth before eating.—E. H. Reeves.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Fighting Tuberculosis in France. *Frank E. Wing.* Survey, May 3, 1919, 42, No. 5, 177-184. —The writer, who has worked with the Bureau of Tuberculosis and the Rockefeller Commission in their crusade against tuberculosis in France, discusses conditions in France at the outbreak of the war and since, and outlines the work which American agencies have done. He points out that the early conception that army life was of necessity the source of much tuberculosis had very little foundation. The spread of the disease has been due rather to: (1) The development of active tuberculosis in soldiers already infected; (2) the development of a large amount of tuberculosis in German prison camps; (3) the spread of the disease among civilians captured in occu-

pied territory; (4) the spread of the disease among refugees from occupied territory who were distributed in various parts of France. At the outbreak of the war France was not making at all adequate provision for the care and checking of tuberculosis. As a result of the war the country became interested in the tuberculous soldier. This interest has been enlarged to include civilian population largely through the medical and educational work begun by the American Red Cross and the Rockefeller Commission in the fall of 1917. It was found that although the French had an excellent theoretical knowledge of the disease and its treatment, our more extensive experience in the field of nation-wide treatment and education has been of great value. Although the American Red Cross has withdrawn from this work since the signing of the armistice, the Rockefeller Commission is planning to continue its service in France for a term of years.—C. H. Paull.

WITH THE RED CROSS IN ITALY. *Seymour H. Stone.* Survey, May 31, 1919, 42, No. 9, 369-370. —Some comments on the crusade against tuberculosis in Italy.—C. H. Paull.

TUBERCULOSIS FINDINGS IN A CITY SURVEY. *D. B. Armstrong.* Public Health Jour., May, 1919, 10, No. 5, 205-211.—Framingham, Mass., was selected for the health and tuberculosis demonstration, on the ground that it was a typical American industrial community. The main points of the article are as follows:

"1. Twenty-seven cases under care January 1, 1918, increased to 181 cases November 15, 1918. Again, the number of cases reported prior to 1917 averaged 14 annually. In 1917, this number jumped to 59. These figures indicate the large number of cases which have come under observation as a result of the more thorough methods of examination and examination 'drives'.

"2. The consultation service has proved a superior instrument for discovering tuberculous cases.

"3. Though Framingham is a typical industrial community, it is affected with less tuberculosis than the registration area as a whole.

"4. An intensive survey will discover a large number of arrested cases requiring minimum medical observation. A large number of early and arrested cases can work and do well under home treatment.

"5. Framingham figures would indicate that there are a million active, and over two million inactive and arrested cases in the United States.

"6. A study of conditions in Framingham offers an excellent opportunity for the study of the relationship of influenza to tuberculosis."—L. A. Shaw.

VENEREAL DISEASE PUBLICATIONS. U. S. Public Health Ser., Pub. Health Rep., April 25, 1919, 34, No. 17, 842-843.—A list of pamphlets now available for distribution either by the state boards of health, or the Public Health Service.—L. A. Shaw.

PREVALENCE OF VENEREAL DISEASE IN THE COMMUNITY. Weekly Bulletin, Dept. of Health, City of New York, May 24, 1919, 8, No. 21, 161-165.—Interesting tables are given, showing the results of examinations for syphilis and gonorrhea in several groups of individuals in New York City. —T. J. Putnam.

MEDICAL AND SOCIAL ASPECTS OF THE VENEREAL DISEASE PROBLEM. *Gordon Bates.* Pub. Health Jour., May, 1919, 10, No. 5, 193-204.—It is estimated that about 8 per cent. of the Canadian population is syphilitic, and that there is a still greater percentage of cases of gonorrhea, yet Canada is without an organization for attacking this health problem. The Ontario Act is a fairly good piece of legislation, but action rather than legislation is the most urgent need. There should be a vigorous educational program instituted. Standard clinics should be established at strategic points. The whole campaign should come under some form of central control. The developments of venereal disease control, both in and out of the army in the United States, provide an example of what can and should be done to combat venereal diseases. (See "A Year's Progress in Venereal Disease Control," by Gertrude Seymour, Soc. Hyg., Jan., 1919, 5, No. 1, 49-66, abstracted p. 54 of this issue.)—L. A. Shaw.

PUBLIC HEALTH SERVICE PROGRAM FOR NATION-WIDE CONTROL OF VENEREAL DISEASES. *C. C. Pierce.* U. S. Pub. Health Ser., Pub. Health Rep., May 16, 1919, 34, No. 20, 1056-1062.—When the United States first entered the war, the first act of the Public Health Service in the campaign against venereal diseases was to attempt to gain the co-operation of the various state boards of health, for the purpose of securing reports of all venereal infections; for the carrying out of repressive measures, such as detention in hospitals of all active cases; for the establishment of free clinics for treatment; and for general education of the public in regard to venereal diseases.

The Chamberlain-Kahn bill of July 9, 1918, provides that, under certain conditions, the sum of $1,000,000 a year for two years may be allotted to each state desiring it, to be used in the campaign against venereal disease along certain standardized lines. Eighteen states have already passed the necessary laws.

Under Amendment No. 7 to the Interstate Quarantine Regulations, in effect November 19, 1918, all persons infected with venereal diseases must have a permit from the local health officer before traveling or moving from one state to another.

Druggists and private physicians have cooperated with the Public Health Service in a most gratifying manner. All physicians participating in the venereal disease control program are being furnished with copies of the manual of treatment of venereal diseases, first issued to the medical officers of the Army.—T. J. Putnam.

SOCIAL HYGIENE LEGISLATION IN 1917. *Joseph Mayer.* Soc. Hyg., Jan., 1919, 5, No. 1, 67-82.—The past decade has witnessed a remarkable change in the standards of vice control in the United States. Segregation and toleration have been replaced by repression and prevention. A

table is included in this article, covering social hygiene legislation by states, showing the subjects dealt with, the bills introduced, and the laws enacted. Finally, a list of the specific bills summarized in the above table contains a brief statement of the subject matter or purpose of each bill, when the bill became a law, and where it may be found.—L. A. Shaw.

A Year's Progress in Venereal Disease Control. *Gertrude Seymour.* Soc. Hyg., Jan., 1919, 5, No. 1, 49-66.—The following suggestions for state board of health regulations for the prevention of venereal diseases, have been approved by the Surgeons-General of the Army, the Navy, and the Public Health Service:

Venereal diseases are declared dangerous to the public health.

1. Venereal diseases are to be reported.
2. Patients are to be given information.
3. Cases are to be investigated.
4. The protection of others from infection by venereally diseased persons is to be attempted.
5. Under certain conditions, the name of the patient is required to be reported.
6. Druggists are forbidden to prescribe for venereal diseases.
7. The spread of venereal disease is unlawful.
8. Prostitution is to be repressed.
9. Giving certificates of freedom from venereal disease is prohibited.
10. Records are to be kept secret.

These recommendations have been made law in all their essentials in forty-two states. In some states, cases are reported to the local health officer; in others, to the state health officer. Special bureaus in state departments of health have developed facilities for the treatment and education of the public as well as of patients, the creation and supervision of clinic work and for social service work. Furthermore, the Chamberlain-Kahn bill, recently passed by Congress, provides for the creation of a Division of Venereal Diseases in the United States Public Health Service, the function of which will be to co-operate with the individual state boards and to assist them in developing their own programs. Each state is to receive an appropriation from this division, made upon a population basis, on condition that a similar amount is appropriated from the funds of the state board, and subject to the further conditions defined by the Secretary of the Treasury. Each state accepting the co-operation of this division has assigned to it a special officer of the Public Health Service. In addition to the measures requiring money only, such as the establishment of facilities for free diagnosis and treatment, legislative measures are required to provide for the reporting of venereal diseases, to eliminate quacks, to prevent treatment by drug-clerks, etc. —L. A. Shaw.

Effect of Metallic Tin and Tin Oxide in Staphylococcus Infections (Furunculosis). *A. Frouin* and *R. Grégoire.* Comptes rendus, 1917, 164, No. 794; abstracted in Centralbl. f. Bacteriol., Ite. Abt., Referate, Nov., 1918, 67, No. 482.—Following the observation that tin workers never suffer from furuncles, the authors tried the effect of tin, tin oxide, and tin chloride on staphylococci *in vitro*, and upon staphylococcus infections.

On aerobic broth and sugar-broth cultures, the tin compounds exerted no growth-inhibiting effects, but the virulence of the cultures was appreciably diminished. In anaerobic culture a growth-inhibiting effect was also evident. Rabbits, inoculated intraperitoneally with staphylococci, had death delayed four to eight days when injected intravenously with 0.1 gm. tin chloride or hydrate twelve hours after inoculation. Daily feeding of 2 gm. of tin or tin oxide for twenty days caused no disturbance in the dog. On the contrary, animals fed metallic tin gained weight.

Fifty cases of furunculosis were given 0.5-1.0 gm. metallic tin or a mixture of tin and the oxide by mouth. In all cases the furuncles disappeared in 5-14 days. No recurrences were observed in six months. Most of these patients had hitherto been unsuccessfully treated by the customary methods and vaccinations.—Barnett Cohen.

A Brief Review of Indirect Contact Transmission and a Preliminary Report of Corroborative Laboratory Research. *James G. Cummings.* Am. Jour. Pub. Health, June, 1919, 9, No. 6, 414-417.—A report of bacteriological tests upon the hands of carriers of various organisms, upon dishes used by them, and upon various other fomites.—T. J. Putnam

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

The Causation and Prevention of Industrial Accidents *H. M. Vernon.* Lancet, April 5, 1919, 146, No. 4988, 549-550.—Every year in England 1000 workers (exclusive of miners) are killed in industrial accidents; 100,000 to 200,000 suffer injuries which incapacitate for one week or more; and 200,000 suffer minor injuries.

The accident records in four munition factories were studied. In one factory the accidents occurring during a ten and a twelve-hour day were tabulated. For the men no marked change occurred, but for the women in the twelve-hour day relatively two and a half times as many accidents occurred as in the ten-hour day,—an excess which must have been due entirely to fatigue.

There was a rise of accidents during the morning spell of work, due partly to increasing speed of production, but more largely to carelessness and inattention. The effect of inattention, as well as that of alcohol, was seen in comparing injuries to day and to night workers. The night workers start work with the highest incidence of injury because their diverting experiences occur before they began and so distract their attention at the start, while day workers have their diversions after work which they look forward to with increasing intensity.

Temperature is an important cause of accidents. When the room temperature was 60°-69° F., accidents were at a minimum; at 72°, they were 21 per cent. more numerous than at 67°; and at 77°, 30 per cent. more numerous. There is a similar increase at temperatures below 60°. Likewise, defective artificial illumination is well known as a cause of accidents.

By means of Committees of Safety formed in factories, by installation of safety devices, etc., certain companies have reduced their accidents by as much as 78 and 88 per cent.—J. C. Aub.

RESPONSIBILITY FOR INDUSTRIAL ACCIDENTS. Labor Gazette, April, 1919, 19, No. 4, 490.—A brief editorial comment on the Annual Report of the Factory Inspector for New Brunswick.—Rhea Fuller.

SAFETY STANDARDS FOR USE IN WORKSHOPS AND FACTORIES IN TENNESSEE. Adopted and Issued by the State Department of Workshop and Factory Inspection, Tennessee.—Schedule No. 1: Machinery Safeguarding as applied to Belts and Pulleys. A pamphlet with diagrams of safeguarding devices.

Schedule No. 2: Safeguarding Stairways, Platforms and Floor Openings. This schedule contains diagrams and discussions of safety devices.—Hazel Andrews.

PROCEEDINGS OF THE THIRD INDUSTRIAL SAFETY CONGRESS OF NEW YORK STATE, Syracuse, New York, Dec. 2-5, 1918. Prepared for publication by the Bur. Statis. and Information, N. Y. State. —The proceedings of the third industrial safety congress of New York State contain a number of extremely interesting and valuable papers. Among these are: WOMEN IN INDUSTRY, Eugene B. Patton, Bureau of Labor Statistics and Information, New York Industrial Commission; WOMEN IN INDUSTRY, John Coughlin, President, Central Labor Union of Brooklyn; WHY, WHAT AND HOW TO INSPECT, John J. Whelan, Aetna Life Insurance Company; MAINTENANCE AND REPAIR AND THEIR RELATION TO SAFETY, Chester C. Rausch, Assistant Director, American Museum of Safety; MACHINERY LAYOUTS AND THEIR RELATION TO SAFETY, Peter C. Spence, Mechanical Engineer, New York Industrial Commission; WOMEN IN INDUSTRY, Mary Van Kleeck, Director, Women in Industry Service, United States Department of Labor; ACCIDENT PREVENTION IN INDUSTRY, David S. Beyer, Liberty Mutual Insurance Company; INFECTIONS, THEIR CAUSE AND EFFECT, Dr. L. A. Shoudy, Chief Surgeon, Bethlehem Steel Company; INFECTIONS, Dr. Raphael Lewy, Chief Medical Examiner, New York Industrial Commission; INFECTIONS—THEIR COST IN TIME AND CASH, A. W. Mowbray, Actuary, New York State Insurance Fund; WHO SHOULD BEAR THE COST OF REHABILITATING WORKMEN?, R. M. Little, Director, American Museum of Safety; THE SAFETY SUPERVISOR—BY WHOM SHOULD HE BE CHOSEN; TO WHOM SHOULD HE BE RESPONSIBLE; WHAT AUTHORITY SHOULD HE HAVE?, Chester C. Rausch, Assistant Director of American Museum of Safety.

The above list of papers is suggestive only. The proceedings contain other valuable material which those interested in safety can well afford to read.—C. H. Paull.

HOW TO GIVE ILLUSTRATED LECTURES ON ACCIDENT PREVENTION TO WORKMEN. *Roy S. Bonsib.* U. S. Dept. Labor, Working Conditions Service, Washington, 1919, 13 pp.—This article is subdivided into Foreword, six Sections, and Conclusion.

Foreword: A recent investigation shows that about 88 per cent. of accidents are due to man failure, and not directly chargeable to machinery. It is, therefore, necessary to educate the workmen themselves in the hazards of their respective occupations.

I. How to Begin the Lecture. Two general methods: (1) opening with an anecdote; (2) opening with a startling statement.

II. How to Analyze the Problem. Show the hazards of the occupation, how they can be avoided by safe practices, and, finally, the suffering which accident brings upon the employee. Illustrated lectures are the most effective means of attracting a man's attention, because they appeal to the emotions, and can be understood by all nationalities and every grade of intelligence.

III. How to Illustrate the Lectures. Lectures may be illustrated in three ways: (1) by slides; (2) by films; or (3) by actual demonstrations of safe and unsafe practices.

IV. How to Arrange an Effective Program. Do not present the obvious and familiar facts pertaining to hazards and their causes, but rather appeal to the men's emotions by depicting the affliction which befalls the household of an injured worker.

V. When is the Best Time to Hold Meetings? The evening from 7.30 to 8.00 has the advantage of catching the men in a restful state of mind; lectures given at 12.30 are better attended, however, because men prefer to spend the evening at home.

VI. Where is the Best Place to Hold Meetings? Meetings should be held in some hall centrally located, and never in the plant. Men see enough of the plant during working hours.

Conclusions. Lectures, to be most effective, should be about thirty to forty minutes long, illustrated with pictures, in the dining hall if given at noon, or outside the plant if given in the evening.—L. A. Shaw.

GENERAL SAFETY MEASURES. Am. Industries Supplement, May, 1919, 19, No. 10.—Contains the layout of a general machine shop which provides for both safety and maximum production. —C. H. Paull.

REDUCING ACCIDENT RISKS. Factory, May, 1919, 22, No. 5, 1108-1114.—Under this heading for May are a number of short contributions, including "Learning Who Is Responsible," "What Makes Good Goggles," "How Important Are Guards."—C. H. Paull.

GOGGLES IN SHIPYARDS. *M. K. Haskins.* Safety Engin., March, 1919, 37, No. 3, 129.—A page of testimony in behalf of the use of goggles for riveters, heaters, caulkers, blacksmiths, etc. The

company in question furnishes the goggles free of charge. The eye injuries have been reduced 54 per cent.—C. K. Reiman.

A Warning to Locomotive Crane Operators. *Chester C. Rausch.* Safety, 7, No. 4, May, 1919, 103-109.—A discussion of five accidents caused by exceeding the safe working limits of locomotive cranes.—G. M. Fair.

INDUSTRIAL SURGERY

Notes on the Treatment of Low Back Strains. *Herman W. Marshall.* Boston Med. and Surg. Jour., April 24, 1919, 180, No. 17, 473-475.—The author recommends a low-worn belt cut from a sheet of thin steel, padded with leather, as superior to adhesive strapping or plaster of Paris. It must, of course, be supplemented by rest and physical therapy.—T. J. Putnam.

Back Pain in the Military Service. *Walter A. Sherwood* and *Merritt L. Jones.* Jour. Am. Med. Assn., May 31, 1919, 72, No. 22, 1599-1604. —The authors group cases of pain in the back as follows:

I. Referred pain:
  A. Aneurysm and mediastinal growths.
  B. Gall-bladder disease, gastric ulcer, etc.
  C. Kidney infections, renal and ureteral calculi and other genito-urinary affections.
  D. Static back.
  E. Prominent abdomen due to deficient musculature, excessive fat, enteroptosis, etc.
II. Functional pain:
  A. Hysteria, malingering, the neuroses and allied conditions.
III. Essential back pain (acute and chronic):
  A. Traumatisms and acute infections.
    1. Sprains, strains, fractures and dislocations.
    2. Perinephritic abscess.
  B. Sacro-iliac conditions.
    1. Infections.
    2. Misplacement.
  C. Sacralization of fifth lumbar vertebra.
  D. Infectious conditions.
    1. Rheumatoid, closely allied to the arthritides in which focal infections may be the cause.
    2. Typhoid.
    3. Tuberculosis.
    4. Syphilis.
    5. Gonorrhea.
    6. Spondylitis deformans, osteo-arthritis, etc.
  E. Congenital malformations.
  F. Curvatures.
    1. End-results of infections.
    2. Rickets.
    3. Postural curves, deficient musculature, etc.
  C. New growths.
    1. Carcinoma.
    2. Sarcoma.
    3. Osteoma, etc.

Details of treatment and diagnosis will be found in the text.—C. K. Drinker.

FATIGUE AND OCCUPATIONAL NEUROSES

Rest Periods for Industrial Workers. Nat. Ind. Conference Board Pub., Research Report No. 13, January, 1919. 55 pp.—This pamphlet is chiefly an analysis of the answers to a schedule of inquiry sent to 388 employers said to have made experiments with rest periods, and of supplementary interviews. The results are critically compared with the available literature, and are tabulated in the appendix.

The investigation appears to indicate that for certain occupations a short recess in the work spell may be desirable from the standpoint of health, and that it may be made advantageous from the standpoint of production. Rest periods have been found especially advantageous in repetitive tasks, heavy work, and work demanding constant sitting or standing. Among the advantages of regular rest periods are the elimination of time waste by putting a stop to irregular pauses, the improvement of discipline, and the cultivation of regular habits among employees with respect to lunches, water drinking, and the use of toilets. In other occupations, however, the nature of the employment affords such opportunity for relaxation that regular rest periods are not required.

Ten minutes, twice a day, is the most common arrangement of rest periods; but they should be adapted to the work and the workers.—T. J. Putnam.

WOMEN AND CHILDREN IN INDUSTRY

Standards for the Employment of Women in Industry. The Woman in Industry Service, U. S. Dept. Labor, Bull. No. 3, March 1, 1919.—A brief account of the standards recommended by the Department of Labor.—T. J. Putnam.

Labor Laws for Women in Industry in Indiana. The Woman in Industry Service, U. S. Dept. Labor, Bull. No. 2, December 31, 1918.—A comparison of the working conditions for women in Indiana with those in other states and abroad.

It is recommended that the number of working hours be restricted to eight, and that means of causing the establishment of proper sanitation and comfort be further studied.—T. J. Putnam.

Bureau of Women in Industry. *James M. Lynch*, Bulletin N. Y. State Industrial Commission, May, 1919, 4, No. 8, 157.—The law forbidding the employment of women in restaurants more than fifty-four hours a week should be extended to third-class cities, which are at present exempt from it. In one restaurant in Niagara Falls, a third class city, the waitresses work 105 hours a week.—T. J. Putnam.

Suitable Work Garments for Women in Industry. *A. W. Guthrie*, Safety, May, 1919, 7, No. 4, 89-102.—The influx of women into the industrial world introduces the factor of personal protection by proper wearing apparel. The writer discusses the advisability of special uniforms, the best head-covering, and the protection of eyes, ears, nose, mouth, and throat.

The safety standards of the Industrial Board, Pennsylvania Department of Labor and Industry, relating to shop clothing for women are of interest:

Section (1). *Uniforms*: From the standpoint of safety, efficiency and appearance, women workers in shops should wear uniforms, the style to be determined by the nature of the work performed, and so designed and worn as not to constitute a hazard.

Section (2). *Caps*: All women working in shops around machinery presenting unprotected hazards shall wear caps. These caps shall be of such fabric and design, and worn in such a manner as to eliminate the possibility of the wearer's hair being caught by moving parts of machinery.

Section (3). *Shoes:* In the interests of safety, health, and efficiency, women workers should wear shoes of comfortable size, with medium and low heels.

Section (4). *Approval*: Before shop uniforms are officially adopted by employees they shall be submitted to the Industrial Board with a description of the work to be performed by the wearer.—G. M. Fair.

Health Supervision of Working Children. *George P. Barth*, American Child, May, 1919, 1, No. 1, 44-47.—While medical inspection of schools is in operation in the large cities throughout the country, child labor laws are concerned only with age and educational qualifications, physical and mental fitness being generally overlooked. Children between the ages of 14 and 15 should work only under permit, and should be subject to an adequate health supervision system. A table which is appended shows that: in five states the officer issuing the permit alone determines physical fitness; in 21 states there are no restrictions; in 11 states the issuing officer may call in a physician in doubtful cases; in 14 states a physician must determine physical fitness.—L. A. Shaw.

The States and Child Labor. U. S. Dept. Labor, Children's Bureau, April 6, 1919, Children's Year Publication No. 13, Bureau Publication No. 58, 46 pp.—"This pamphlet summarizes briefly the age and hour restrictions placed by the various state laws upon the employment of children under 16 in factories, and the employment of boys in mines. These regulations are of two types—labor laws, fixing minimum age and maximum hours and prohibiting night work, and compulsory school attendance laws, which constitute in effect prohibitions of employment during the hours when they require the attendance of children at school."—T. J. Putnam.

Medical Argument Against Night Work Especially for Women Employees. *Emery R. Hayhurst*, Am. Jour. Pub. Health, May, 1919, 9, No. 5, 367-368.—Hayhurst argues against night work, especially for women, since it increases all the factors responsible for chronic fatigue, due to disturbances in normal sleep, rest, recreation, food and amount of strain. The tonic effect of exercise in daylight is lost; recreation loses the incentive and stimulus of association with others; and the shifts necessary from day to night duty and reverse upset normal habits. Night work has been shown in England by the British Health of Munition Workers Committee to be responsible for almost double the number of accidents, especially during the period of lowest vitality from 2 to 6 A. M. German records show a constant increase in the number of cases of illness among night workers over day workers.

The irregularities due to shifting hours are especially harmful to women with menstrual disturbances, and married women have less opportunity to nurse their babies when on night duty. —H. F. Smyth.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Present Status of Industrial Lighting Codes. Parts II and III. *G. H. Stickney*. Am. Arch., May 28 and June 11, 1919, 115, Nos. 2266 and 2268, 771-772, and 835-836.—(*Part I* abstracted in The Journal of Industrial Hygiene, July, 1919, 1, No. 3, 42.)

Part II. The writer considers the establishment of proper limits for the glare which he believes is even more important than the matter of intensity. The distribution of light is discussed in relation to intensity and glare limit specifications. Emergency lighting is treated at length

Part III. The writer concludes this paper with a discussion of switching and controlling apparatus, and of the enforcement of the regulations of the industrial lighting codes in existence.—G. M. Fair.

Sanitation for Government Munition Plants. Metal Worker, etc., May 30, 1919, 91,

No. 22, 681-682.—This article lists some of the regulations issued by the United States Public Health Service. The regulations were prepared by the Committee on Labor of the Council of National Defence, and relate to ventilation, and washing and toilet facilities.—G. M. Fair.

THE HEATING AND VENTILATION OF WORKSHOPS. Part I. Engineer, May 23, 1919, 127, 504-506.—A description of certain characteristic installations which were brought into use in some works erected during the war. The first installation described is that of the Daimler Company, Ltd., Coventry, England.—G. M. Fair.

WHAT IT PAYS TO KNOW ABOUT FACTORY WATER SUPPLY *Charles L Hubbard.* Factory, May, 1919, 22, No. 5, 919-923.—This article is a practical discussion of three essential qualities of drinking water in factories: quantity, purity, and temperature. It points out that quantity required depends upon the character of work, conditions of climate and type of drinking fountain. Great care should be taken to see that drinking water is either protected from contamination or that the contamination is removed before the water reaches the worker. Filtration removes solid matter which may be injurious or simply unpleasant. Three methods of sterilizing are suggested to fit different needs: chlorination, treatment with ultra-violet rays, or distillation. Illustrative drawings are given to show both the ice and the refrigerating plant method of cooling. —C. H. Paull.

TRADE-WASTE TREATMENT STUDIES IN WISCONSIN. *E. J. Tully*, Engin. N.-R., June 12, 1919, 82, No. 24, 1167-1168.—The Division of Sanitary Engineering of the Wisconsin State Board of Health has devoted particular attention for some time to the prevention of water pollution by industrial wastes. The aim in selecting the system of treatment has been to combine effectiveness with simplicity of construction, reasonableness in cost, and simplicity of operation, to eliminate technical supervision, and to include recovery or partial recovery of waste products, as this is the ideal solution when feasible. An outline of the work already accomplished and the method of attack is given.—G. M. Fair.

EXHAUST REMOVAL OF PLANING MILL WASTES. Metal Worker, etc., June 6, 1919, 91, No. 23, 714-717.—Discusses the equipment necessary for the removal of sawdust, shavings, chips, and other fine waste from woodworking machinery.—G. M. Fair.

PRIVATE FIRE PROTECTION. Munic. Jour. and Public Works, June 21, 1919, 46, No. 25, 449-451. —Report of the Committee of the American Water Works Association, giving recommendations for procedure in installing and charging for private fire devices.—G. M. Fair.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

KEEPING WORKERS WELL—THE PART THE FACTORY DENTIST PLAYS. *Ralph W. Elliott*, Factory, May, 1919, 22, No. 5, 924-925.—The work of the dental dispensary as outlined from the experience of the National Lamp Works of the General Electric Company includes: first, the relief of pain; second, examination and consultation; third, prophylaxis; fourth, consultation with the medical department; fifth, filling, treating, and extracting. Dr. Elliott points to the necessity of making frequent examinations available to employees. By co-operation between the medical and dental departments, much absence can be eliminated, and employees will accept this service intelligently and with appreciation.—C. H. Paull.

INDUSTRIAL HOSPITAL SERVES WHOLE COMMUNITY. Hospital Management, May, 1919, 7, No. 4, 32.—A brief statement of the establishment of a twelve-bed hospital by the Clark Equipment Company of Buchanan, Michigan, which serves both plant and town.—Katherine R. Drinker.

THE RELATION OF THE HOSPITAL TO THE COMPENSATION INSURANCE COMPANIES. Mod. Hosp., April, 1919, 12, No. 4, 274-296.—Many large industrial plants have established plant dispensaries, but the bulk of industrial accident cases must continue to be handled by public hospitals. The Liberty Mutual Insurance Company of Boston has established surgical departments of its own in important industrial centers. In these dispensaries it has been planned to save all the time possible for the emnloyers and employees. These cases handled by the public hospitals in the routine way result in the loss of many hours of productive time. An important feature of this work is the elimination of waiting in out-patient departments. Many of the minor injuries can be dressed at noon hours.—H. A. Bulger.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

RECONSTRUCTION IN GREAT BRITAIN. *Thomas Adams.* Nat. Munic. Rev., March, 1919, 8, No. 2.—In this article the author discusses the problem of housing for the poor and town planning. On page 123—"Decentralization of Industries and Town Planning"—he brings out the tendency of modern industry today to buy rural tracts of land for factory sites, near which it builds its own towns. Particular mention is made of such a site bought by the U. S. Steel Corporation in Ontario. "Town planning, in the judgment of the U. S. Steel Corporation, was the first neces-

sity of its housing scheme." Considerable space is given to government and municipal plans for solving the housing problem.—Linda James.

Better Housing in Iowa. Iowa State Board of Health, Bulletin No. 9, Jan.-June, 1919, 4, Nos. 1 and 2, 3-48—This report treats the question of housing from various angles. There are separate articles on better housing, scope of a state housing law, housing and health, woman's interest in a state housing law, the importance of better housing from the standpoint of the employee and the need of a state law regulating housing. Each of these subjects is discussed by a different writer. The report ends with a statement of the proposed state housing law.—Hazel Andrews.

Report of the Housing Committee of the Dominion Cabinet. Labor Gazette, April, 1919, 19, 4, 447-450.—The Dominion Government has set aside $25,000,000 to be used for the purpose of promoting better housing and building conditions throughout the provinces. In order to accomplish this, the laboring man is to have the opportunity of acquiring his own home at actual cost of the building and land.—Rhea Fuller.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

Mental Tests in Industry. *J. Crosby Chapman.* Personnel, March, 1919, 1, No. 3, 1 & 9.—An attempt to help the employment managers find the right man for the right job by means of simple mental tests, similar to those used in the U. S. Army.—Rhea Fuller.

Report of the Psychology Committee of the National Research Council. *R. M. Yerkes.* Psychological Rev., March, 1919, 26, No. 2, 83-149. —This is a preliminary report of the services of psychology to the United States Government in the war Details of the organization of the work are given, and brief reports of the psychological investigations carried on for different branches of the service. The development and application of the methods of examining recruits is of most interest. The results of this psychological examining in the army have, in the opinion of Major Yerkes, two important bearings. Their primary significance is in connection with the development and improvement of methods of mental measurement which are applicable to industrial, educational, military and other practical situations. The most important achievement is the creation of a practical, serviceable, and reasonably reliable method of group examining by which, if necessary, as many as 500 individuals may be examined at one time. The scientific data accumulated constitute the second important result. The effect of this work upon industry, education and upon several other activities will be profound. Complete reports of the psychological work are being prepared and will be published in a series of volumes. These will include a volume presenting the results of the examination of 1,600,000 soldiers.—G. E. Partridge.

Systematic Study of the Personality in Estimating Adaptability. *A. S. Amsden.* Arch. Neurol. and Psychiat., March, 1919, 1, No. 3, 301-312.—A paper giving examples of concise personality studies and showing the value of such studies in neuropsychiatric cases. A well-taken history of this sort may explain the patient's break-down, and point the way to changes in the occupation and environment which would be of therapeutic value.—S. Cobb.

The Psychoneurotic Temperament and Its Reactions to Military Service. *E. F. Ballard.* The Alienist and Neurologist, Jan., 1919, 40, No. 1, 49-55. Reprinted from Journal of Mental Science.—Six varieties of temperament of the class discussed are recognized: hysterical, psychoasthenic, epileptic, paranoiacal, manic-depressive and dementia precox. Quantitative reports are not given, but there are statements about the manifestations of these temperaments under service, and about practical limitations and needs of the various types.—G. E. Partridge.

Army Personnel Work: With Some Implications for Education and Industry *W. V. Bingham.* Jour. Applied Psychology, March, 1919, 3, No. 1, 1-12.—Every practical problem of personnel in war, industry, business or education presents at least three phases: study of the work to be performed; inventory of the individual man; placement of the man. Analysis of the work is the most neglected of these at the present time.—G. E. Partridge.

A Standardized Group Examination of Intelligence Independent of Language. *E. L. Thorndike* Jour. Applied Psychology, March, 1919, 3, No. 1, 13-32.—This is a further development of the methods of examination of large groups of persons at one time by a single examiner, such as have been used by the Metropolitan Life Insurance Company, and later in the United States Army. The tests may be obtained from the Bureau of Publications, Teachers' College, Columbia.—G. E. Partridge.

Principles Underlying the Classification of Men. *T. L. Kelley.* Jour. Applied Psychology, April, 1919, 3, No. 1, 50-67.—This is an important paper, dealing mathematically with the problem of analysis of capacity. A correlation of 0.875 is found between vocational choice and certain other factors which are not general intelligence. A task analysis should throw light upon what constitutes this large field. Such studies as this indicate both the intricacy and the definite practicability of the problem of adjusting the man to the task.—G. E. Partridge.

THE NEED OF MENTAL EFFICIENCY. *J. M. Keniston.* The Alienist and Neurologist, April, 1919, 40, No. 2, 126-130.—A plea for more adequate recognition of the problems of mental efficiency, and a wide extension of such work as that of the eugenics societies. The goal is the scientific estimation of every individual, making possible higher efficiency and effective mobilization for every public service.—G. E. Partridge.

THE PSYCHOLOGY OF VOCATION. *S. De Sanctis.* Rivista di Psicologia, Jan.-Feb., 1919, 15, No. 1, 30-69.—This is an excellent appreciation and analysis of the problems of vocational psychology, considered as a scientific basis for the work of utilizing the individual to his own advantage and to the advantage of the social group in which he lives. A broad conception of the function of practical psychology is taken, and the author recognizes two somewhat different aspects of vocation, and correspondingly two problems and methods. He speaks of *internal* and *external* vocation. Internal vocation must be determined by individual methods that aim to discover hereditary and other fundamental factors of disposition and attitude. The method here must be intimate. Even the exploration of the subconscious must be resorted to. External vocation is a matter of various abilities and functions that can in part be measured by mass methods; and we have at hand already the well-developed technique of individual psychology. There is frequent reference in the paper to American labors in this field.—G. E. Partridge.

THE FIELD OF THE CLINICAL PSYCHOLOGIST AND THE KIND OF TRAINING NEEDED BY THE PSYCHOLOGICAL EXAMINER. *J. E. W. Wallin.* School and Society, Apr. 19, 1919, 9, No. 225, 463-470.—The fields of applied psychology are now so rapidly being differentiated that common and general preparation is no longer sufficient. The case of the clinical psychologist as a legitimate expert, now well qualified in certain fields of mental diagnosis and the like, is presented.—G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

MEASUREABLE EFFECTS OF WELFARE WORK IN INDUSTRY. The Playground, Jan., 1919, 12, No. 10, 428-434.—Brief summary of recent efforts: effects of changes in hours and wages, type of work place, sanitation, safety, education and organization, health movement, recreation, education, housing, supervision.—G. E. Partridge.

INDUSTRIAL HEALTH LEGISLATION AND COURT DECISIONS: MALINGERING

LABOR LAWS, REVISION OF 1918. DEPARTMENT OF LABOR AND FACTORY INSPECTION, BUREAU OF LABOR STATISTICS, STATE OF CONNECTICUT.—All the laws relating to labor are here published. Those of special interest in connection with industrial hygiene are concerned with factory inspection, employment of children, employment of women, fire regulations, safety in relation to public service companies, workmen's compensation and employers' and workmen's insurance.—Hazel Andrews.

SIXTEENTH BIENNIAL REPORT, 1917-1918, DEPARTMENTS OF LABOR AND COMPENSATION, STATE OF NEBRASKA.—The Female Labor Law is quoted in full, the main features being the section requiring employers to furnish seats and to post the hours of work. The Child Labor Law is discussed briefly and the Mothers' Pension Law is quoted. The law establishing a Minimum Wage Commission and providing for a minimum wage for women and minors is given. A number of safety-first devices are suggested and the General Factory Inspection Law and the Building Laws are quoted.

Part II of the report deals with the Workmen's Compensation Law.—Hazel Andrews.

THE QUEBEC INDUSTRIAL ESTABLISHMENTS (AMENDMENT) ACT RESPECTING CHILD LABOR. Labor Gazette, April, 1919, 19, 4, 496.—Children under 16 years working in an industrial establishment must have a certificate of study and must produce it when called upon. The form of the certificates, drawn up by the chief inspector, is uniform throughout the province.—Rhea Fuller.

MINIMUM WAGES FOR FEMALE EMPLOYEES IN MANITOBA. Labor Gazette, April, 1919, 19, 4, 470-471.—A brief article containing a table of wages and hours for female employees in Manitoba in the trades of dyeing and cleaning and of hairdressing.—Rhea Fuller.

THE MEDICO-LEGAL PROBLEM OF HYSTERO-TRAUMATISM. *A. Pitres* and *H. Verger.* Rev. de Méd., January, 1919, No. 1, 4-47.—The authors tell of the difficulties of the French law of 1898 on industrial accidents, in regard to invalidity of undetermined duration in cases of traumatic neurosis. They mention Brissaud's work on *Sinistrosis* (malingering) of 1907. Before the war the most satisfactory compromise, usually accepted by the courts, consisted in assessing functional disabilities, supposedly curable, considerably lower than incurable organic lesions.

They speak also of the unfortunate results of the doctrine of "pithiatism," the purely suggestive theory of hysteria, during the war. They criticize its foundations, and deplore its results: coercive treatment, systematic denial of pensions and compensations, not only to the exaggerators and prevaricators, but to the sincere hystero-traumatic patients.

Finally, they indicate the steps to be taken by the pension officers in the examination of hys-

terics, and the determination of the extent of compensation of those uncured after appropriate treatment. The settlement should be as follows:

1. In the cases of real hystero-traumatism: full pension, and compensation corresponding to the degree of invalidity.

2. In case of persistence of symptoms from habit or want of will: temporary pension, and correspondingly reduced compensation.

3. In cases of proved exaggeration: the compensation should be reduced as much as possible. —T. J. Putnam.

WORKMEN'S COMPENSATION AND INSURANCE

Compensation for Occupational Diseases in the United States and Foreign Countries. *Carl Hookstadt.* U. S. Bur. Labor Statis., Month. Labor Rev., April, 1919, 8, No. 4, 200-209.—With the exception of certain provisions made in Great Britain and in most of her colonies, occupational diseases are in general not compensable at present. In the United States there are four exceptions to this: California, Hawaii, Massachusetts, and the federal government. In all other states occupational diseases are excluded from compensation.

Occupational diseases are classified by Hookstadt as follows:

1. Diseases due to gradual absorption of poisons: e. g., lead poisoning.
2. Diseases, the germs of which enter the system through the skin: e. g., anthrax.
3. Skin affections from acid or other irritants: e. g., eczema.
4. Disease due to fumes or dust entering the system through the respiratory organs: e. g., tuberculosis.
5. Diseases due to vocations or constant use of particular members: e. g., telegraphers' cramp.
6. Miscellaneous diseases: e. g., caisson disease.

The states have varied in their decisions as to whether all, except the first of the above six types of diseases, are strictly occupational diseases. Although several of the states not allowing compensation for industrial diseases have viewed certain of these classes of diseases from the standpoint of accidents, all of these states have been relatively uniform in the legal theories and principals underlying their decisions. Compensation for occupational diseases has usually been granted under accident provisions if one or more of the following conditions existed:

1. If the disease resulted in violence to the physical structure of the body.
2. If the injury occurred unexpectedly or out of the usual course of events.
3. If the injury could be traced to a definite time and place of employment.
4. If the injury was not due to a known and inherent risk of the occupation.

In the absence of definite provision for compensation for occupational diseases, there has been a tendency to interpret accident compensation laws as broadly as possible.

In Great Britain occupational diseases have been compensable under the Workmen's Compensation Act since 1906. The law that year provided for compensation in case of specified diseases. Since 1916 this list of diseases has been enlarged (see table, page 206, of Hookstadt's discussion). The Canadian provinces have instituted similar legislation modeled after the British Act of 1906. In most of the European countries occupational diseases are cared for through compulsory sickness and invalidity insurance, though there is a tendency at present to include occupational diseases under the accident insurance laws. —C. H. Paull.

Health Insurance, the Medical Profession, and the Public Health *B. S. Warren.* U. S. Pub. Health Ser., Pub. Health Rep., April 18, 1919, 34, No. 16, 775-789.—Health insurance is a method whereby a group of individuals share the economic loss due to sickness. By careful gathering of data from chosen units of population the "sickness expectancy" or rate of sickness may be determined. The author has collected valuable data from many sick benefit associations, and from these data an estimate is given of an average annual rate of sickness of 9 days per injured person.

Health insurance would require the working out of a method for remunerating the physicians. The contract system which is now in use in many government services, or some other method, might be satisfactorily worked out. A panel of physicians from whom those sick may take their choice is suggested, the pay to be by fee, yearly contract, or part-time contract basis. The "premium on sickness" would be remedied by health insurance.

In the working out of the plan the existing health organizations should be used, to avoid duplicating of work. A medical referee would have to be detailed to each group of about 4000 insured persons. He would decide upon the nature of sickness and the length of disability, and should not be dependent upon the local unit for his position. Selection of referees should be by examination, both physical and mental. By proper effort there could be built up a strong state organization for health.—E. H. Reeves.

First Annual Report of South Dakota Industrial Commissioner for the Twelve Months Ending June 30, 1918.—This report deals entirely with the Workmen's Compensation Law. The workings of the law are discussed and sections of it are criticized. Its relation to threshers and to agricultural employees receives special attention. Statistics concerning the number of accidents and fatalities and the number of compensations awarded are given.—Hazel Andrews.

First Annual Report of the Industrial Accident Board of the State of Idaho, 1918.—This report deals entirely with compensation, discussing the history of compensation legisla-

tion in the United States, the organization and preparation of the Workmen's Compensation Board, and the history of compensation legislation in Idaho. The general provisions of the Idaho law are given, with statistics on cases.—Hazel Andrews.

REHABILITATION OF DISABLED EMPLOYEES

Index-Catalogue of a Library on Rehabilitation of the Disabled. *Douglas C. McMurtrie.* Am. Jour. Care Cripples, March, 1919, 8, No. 3, 191-295.—This large library includes many articles in German periodicals. The index-catalogue makes a useful bibliography of the subject.—T. J. Putnam.

Publications of the Federal Board for Vocational Education. Washington, Feb., 1919, 23 pp.—A list and description of the publications of the Board.

Two *Annual Reports* have been issued, describing the organization and work of the Board.

The *Bulletins* prepared by the Board are pamphlets of from 15 to 300 pages each. The majority of them are outlines of practical courses in various trades, industries and vocations, and in agriculture. Bulletin No. 1 is a detailed statement of the policies and methods of the Board Bulletin No. 23, Clothing for the Family, is the first of a series on Home Economics. About 30 bulletins are now ready.

The *Rehabilitation Leaflets* are addressed to discharged and disabled soldiers, sailors and officers. They describe in a general way the aims and methods of the Board.

The *Opportunity Monographs* are from 5 to 40 pages long. They are intended for the discharged service man, to help him decide what occupation to adopt or to train for. A sketch of each kind of work is given, and the training and qualifications desirable in it are outlined. Special attention is given to the possibilities of employment of cripples. About 40 of these pamphlets are already published.

All these publications are free for distribution, and may be had by application to the Federal Board for Vocational Education, Washington, D. C.—T. J. Putnam.

Normalizing the Industrial Cripple. *Elizabeth G. Upham.* Am. Industries, May, 1919, 19, No. 10, 30.—This is a short but thoughtful discussion of some of the differences in mental outlook in the war and in the industrial cripple.—C. H. Paull.

Training for Disabled Soldiers and Sailors *Arnold Levitas.* Educational Review, April, 1919, 57, No. 4, 312-320.—The great number of disabled men now returned to industrial life, and the great variety of disabilities introduce new problems, the solution of which falls in part upon the government. There must be a development of vocational and research bureaus, and industries must be considered analytically to meet the new difficulties of adjustment.—G. E. Partridge.

The Rehabilitation of Disabled Soldiers and Sailors or Victims of Industry. *C. H. Winslow.* The Jour. Nat. Education Assn., April, 1919, 3, No. 8, 521-522.—It is the duty of the government to replace the men of the army in industry, with due regard to the capabilities of the individual. This is a part of the grim business of war, and is no philanthropic venture. The recuperative and competitive power of the nation is dependent upon it.—G. E. Partridge.

Opportunities for Handicapped Men in the Brush Industry. *Charles H. Paull.* Publications of the Red Cross Institute for Crippled and Disabled Men. May 1, 1919, Series 2, No. 7, 56 pp.—The brush industry is a large and well-established one in the United States, employing over 7,000 persons in 1914. The operations are very varied, and for the most part, moderately skilled. The wages range from $12 to $30 a week. The various operations are described in sufficient detail to give an understanding of the sort of labor required, and the types of disability to which each is adapted. A large majority of the operations can be carried on by men who have lost one or both legs, or two or three fingers, or who have hernia, heart trouble, or defective hearing. Two of them can be adapted to blind men, and two others to men who have lost an arm or a hand. An excellent cross-index is furnished.—T. J. Putnam.

Industrial Surveys of the Leather Industries. *Gerald A Boate.* Am. Jour. Care Cripples, Feb., 1919, 8, No. 2, 125-160.—This survey was undertaken with special reference to the possibilities of the employment of cripples, the opportunities for training them, and the permanence and desirability of the work for them. A majority of the operations of the leather trade are covered.—T. J. Putnam.

Governmental Provision for the Blinded Soldier. *James Bradley.* Am. Jour. Care Cripples, April, 1919, 8, No. 4, 310-313.—Teaching the proper attitude must come first. The courses given are divided into required and selected. The required courses include physical training, personal hygiene, fundamental hand training, reading, writing of Braille, and typewriting. The elective courses involve individual treatment, taking into consideration the man's previous occupation, opportunities for occupation in his own home, and his temperament. The elective courses may be classified as industrial, agricultural, and home work. After a certain amount of training in these subjects, a man may receive further instruction under the guidance and at the expense of the Federal Board for Vocational Education. No occupation is taught in which the economic advantage to both the employer and the employee is not clearly manifest.—L. A. Shaw.

ABSTRACT *of the* LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME I — SEPTEMBER, 1919 — NUMBER 5

CONTENTS

GENERAL

LABOR ADMINISTRATION IN THE SHIPBUILDING INDUSTRY DURING WAR TIME. II. *P. H. Douglas* and *F. E. Wolfe*. Jour. Pol. Econ., May, 1919, 27, No. 5, 362-396.—This is the second article of the series. It elaborates on the functioning of the organizations described at length in the first article. On page 380 is a brief description of the Health and Sanitation Section of the Fleet Corporation.

"The field sanitary engineers inspected the shipyards every thirty days. The section supervised and organized first-aid work for injured men and provisions for medical attention, dispensary and hospital facilities, medical inspection and quarantine. It improved the sanitation about the shipyards as to water supply, toilets, sewage disposal, bathing facilities, pure food, and mosquito extermination. . . . Vaccine and typhoid serums were supplied to all yards when needed."

Following this is an explanation of the work of the Safety Engineering Section. "It seems probable that, as a result of safety measures, from 12,000 to 13,000 fewer accidents occurred during the last quarter of 1918 alone than would have occurred had the pre-war conditions existed. Such a showing is all the more remarkable when the sudden expansion of the industry and the addition of nearly 300,000 'green men' is considered. . . . Sixty-nine shipbuilding companies were enabled to secure a reduction in their insurance premiums because of the safety measures introduced at the instance of the Safety Engineering Section. This reduction totaled in all several millions of dollars."—Linda James.

CONFERENCE ON BUSINESS TRAINING FOR ENGINEERS AND ENGINEERING TRAINING FOR STUDENTS OF BUSINESS. School and Society, July 12, 1919, 10, No. 237, 44-45.—This is a report of a conference called by the Commissioner of Education at Washington on June 23 and 24 on be-

half of the Conference Committee on Commercial Engineering. The purpose was to direct public attention to the need in our country for an increasing supply of well-trained men, combining the engineering and the economic points of view. In large scale industrial production and commercial enterprise, the man of the future most helpful in eliminating waste of machinery, materials, and men, will be the man whose training will represent the principles both of engineering and business practice.—G. E. Partridge.

Physical Rejection for Military Service: Some Problems of Reconstruction. *J. H. Beard.* Scientific Monthly, July, 1919, 9, No. 1, 5-14.—The draft has been a great inventory of the resources of the nation; it has shown both our physical assets and our human liabilities. There is evidence that from 50 to 60 per cent. of the men between 31 and 46 years of age could not have passed for general military service if the physical requirements had remained unchanged. An examination of the causes for rejection shows that many defects could have been prevented or promptly cured. The lesson to be learned, in the interest of conserving the power of the nation, is that physical education and preventive and corrective measures in general must be regarded as an all-important part of the work of reconstruction. The paper contains a table showing the total number of rejections for various causes, and some of the causes are discussed with reference to their prevention or correction.—G. E. Partridge.

Physical Education in the Light of the Present National Situation. *A. D. Browne.* Am. Physical Education Rev., Feb., 1919, 24, No. 2, 69-74.—Experiences of the war have shown that as a nation we are physically unfit, both for war and for work. About 45 per cent. of the men examined for the army were rejected. Radical change in the situation can be made only by beginning in the schools and educating the public to understand the importance of physical training, which must include something more individual and more technical than games and group exercises. We must begin now to train in the grammar school for military service, by physical training methods, and with this there must be a careful estimation of the physical status of all pupils. Thus two objects will be gained, and advantage taken of the momentum of public interest.—G. E. Partridge.

What the War Should Do for Our Methods in Physical Education. *E. H. Arnold.* Jour. Nat. Education Assn., May, 1919, 3, No. 9, 631-634.—The experiences of war have shown that many men who are now unqualified may be made fit for service by methods of physical training. The fact that one-third of the men in the prime of life are unfit for war suggests a serious problem. It is quite evident from the statistics that neither nativity, nor industrial conditions, nor city or country life, nor presence or absence of physical education in the narrower sense has influenced the physical unfitness to any great extent, but that the cause must be sought in hygienic conditions. Physical education and the teaching of hygiene are the remedies.—G. E. Partridge.

Selected Bibliography of Physical Training and Hygiene. *G. B. Affleck.* Am. Physical Education Rev., Jan., 1919, 24, No. 1, 17-26; March, 1919, 24, No. 3, 147-154; April, 1919, 24, No. 4, 213-218.—Includes several topics of interest to the student of industrial hygiene.—G. E. Partridge.

The Eugenic Aspect of Selective Conscription. *R. H. Johnson.* Scientific Monthly, July, 1919, 9, No. 1, 15-17.—Common sense and consideration for the future ought to be displayed to a greater extent in the selection of men for military service and in the details of assignment to duty, in such a way as to make the service as little wasteful as possible of valuable men and valuable qualities in the race.—G. E. Partridge.

What the War Should Do for Our Methods in Vocational Education. *W. J. Bogan.* Jour. Nat. Education Assn., May, 1919, 3, No. 9, 637-641.—The war has proved that the public schools are able to give a very practical training, at the same time stimulating ambition and fostering a true Americanism, and developing respect for skilled work. We see now that the school is the only place where trades can be taught, using school in a broad sense. The day of the fancy glove-box in manual training work has gone, and the war has shown the great interest that can be created in producing practical results. The war has taught the value of speed in school shops. Previously time had been wholly neglected as a factor, and the shop work of the schools conducted as though life were eternal. A serious defect in the traditional schools was their practice of digging broad but shallow foundations. The war has taught the value of intensive shop and drawing courses planned for a specific need. The war has demonstrated the need of co-operation between the schools and industry. The war has proved that boys thrive under the pressure of responsibility.—G. E. Partridge.

The Foundation of a German Society for Social Hygiene. *W. Hanauer.* Archiv für soziale Hygiene und Demographie, Aug., 1915, 2, No. 1, 1-9.—Plans are outlined for an organization for the promotion of the interests that are centered in the field of social hygiene as separate from public hygiene and other aspects of hygiene that may be differentiated from social hygiene. The especial problems of social hygiene have arisen with increasing industrialization, concentration of population, etc., and so far the most characteristic practical results are in the nature of industrial laws and means of safeguarding labor.—G. E. Partridge.

Chronicles of Social Hygiene. *A. Elster.* Öffentliche Gesundheitspflege, 1916, 1, 3, 175-188. Received July 9, 1919.—*Öffentliche Gesundheitspflege* is apparently a continuation of *der Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege*, which ends with the forty-

seventh volume, the new publication appearing monthly. Dr. Elster's article is a brief review of advances in the field of social hygiene, and these reports are to be continued each month. The present review includes studies of population, school hygiene and the care of children, the effects of the war, prevention of contagion, nutrition, industrial hygiene and social insurance, housing. —G. E. Partridge.

Human Relations Department from the Standpoint of the Industrial Physician. *Otto P. Geier.* Ind. Management, June, 1919, 57, No. 6, 503-504.—The least important work which the industrial physician does is the hasty physical examination of applicants for employment, and attention to minor injuries. He should be the point of most intimate contact between the company and the men, should see that safety and sanitary devices are kept in service and in good order, and should encourage the employees to come to him for examination and advice whenever they are sick.—T. J. Putnam.

Human Relations and the Industrial Physician. *Robert S. Quimby.* Ind. Management, June, 1919, 57, No. 6, 503a-503b.—The scope of an adequate health program includes the following main activities:

1. Physical examination at the time of hiring, and subsequently as conditions indicate.
2. Advice to the employment department as to the proper placement of defectives.
3. Supervision and follow-up treatment of these defectives.
4. Facilities for the treatment of medical, surgical, dental, ocular, and other types of cases.
5. Investigation and, in many cases, nursing and medical treatment of home cases.
6. A system of benefits sufficiently adequate to tide over the disability period.—T. J. Putnam.

Health of Ohio Coal Miners. III. *Emery R. Hayhurst.* Ohio Pub. Health Jour., April, 1919, 10, No. 4, 166-170.—The medical care of the Ohio mining industry is supervised by the workers themselves, if any is given. Organizations for such purposes depend upon (1) the size of the working force, (2) the location of the mine in respect to towns and cities, (3) the racial complexion and (4) the attitude of the local union. Sick benefit associations are apparently decreasing in number, whereas the national fraternal secret sick benefit associations are well represented and include about 50 per cent. of the miners. Practically all the foreigners belong to one or more associations. The usual forms of industrial insurance are everywhere present. The benefits derived from state compensation for injuries are evident. Death benefit associations are also everywhere.

A first-aid equipment meets with the bare requirements of the law. Injured men are rushed to any convenient place for first-aid treatment and then home, where they come under the supervision of their own physicians. No physical examinations of applicants for work are made. In the case of an epidemic, everything is left to the local health authority. The trained nurse is almost unknown.

Figures are given on the following topics: Stability of medical practice, contract practice, fee rates, ratio of physicians to population, and non-medical practitioners.—L. A. Shaw.

Traffic in Narcotic Drugs. Report of Special Narcotic Committee, Treasury Dept., June, 1919, 29 pp.—This report deals with the traffic in opium and coca leaves, their preparations and habit-forming alkaloids, which are covered by the Harrison Act. Statements and tables applying to the legitimate traffic in these drugs are given. The "underground" traffic is estimated to be equal in magnitude to the legitimate traffic. That the consumption of narcotic drugs in this country has steadily increased from the date of their introduction is clearly shown by one table; and by another, the fact that this country consumes from thirteen to seventy-two times as much opium per capita as is consumed by European countries. The per capita consumption of both cocaine and opium in this country, making due allowance for that used for legitimate purposes, gives us some idea of the extent to which these drugs are used for the satisfaction of addiction. For the purpose of compiling statistics, questionnaires were sent out to all physicians registered under the Harrison Narcotic Act, for data as to the number of addicts under treatment by them, and to druggists for a statement of narcotic prescriptions filled. The tables indicate that there are 237,655 addicts and 18,299,397 prescriptions containing narcotic drugs yearly. Questionnaires were likewise sent out to the chiefs of police of all cities in the United States with a population of 5000 or more, to penal institutions, to almshouses, to municipal health officers and to private hospitals and sanatoria.

Detailed statistics are included of the sales of narcotic preparations dispensed, which are exempt under the law. There is a summary of the article followed by conclusions and recommendations. Legislation providing for the treatment of addicts is much needed. The question of international traffic in opium and cocaine should be taken up as soon as possible, especially with Canada and with Mexico. Public educational campaigns should be instituted, and physicians and hospitals should be provided with facilities for research into the nature and treatment of drug addiction. The manufacture and administration of heroin should be absolutely forbidden, as the medical need for it is negligible compared with its evil uses, and it can easily be replaced without therapeutic loss with other safer morphine derivatives.—L. A. Shaw.

Narcotic Drug Control. *W. R. Herrick.* City of New York, Weekly Bull. of the Dept. of Health, July 12, 1919, 8, No. 28, 218-221.—The State Commissioner of the Department of Narcotic Drug Control of New York City has promulgated sixteen rules and regulations to cover the dispensing of cocaine and opium to drug addicts.—L. A. Shaw.

Effects of Smoking on Mental and Motor

EFFICIENCY. *O. J. Johnson.* The Psychological Clinic, May 15, 1919, 12, Nos. 5-9, 230-235.—The tests used were aiming, tapping, color naming, addition, steadiness. The subject usually took the tests at 4.30 P. M., then smoked a cigar, then repeated the tests at intervals in the evening and the next morning. The writer concludes that the effects of smoking are very detrimental to muscular control and also to the purely mental processes studied.—G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

FIGHTING CANCER WITH FACTS. American Society for the Control of Cancer, 25 West 45th St., New York City, Feb., 1916, 8 pp.—The society is conducting a nation-wide campaign "to disseminate knowledge concerning the symptoms, diagnosis, prevention, and treatment of cancer, to investigate the conditions under which cancer is found and to compile statistics in regard thereto." This is one of the leaflets published for popular distribution by the society. Others are: *What You Should Know About Cancer; How the Public Health Nurse Can Help to Control Cancer; What to Do About Cancer* (reprinted from the Providence Journal); *Cancer—a Curable Disease* (reprinted from the Woman's Magazine); *Whitelaw's Experience* (reprinted from the Medical Times); *Free Tumor Diagnosis as a Function of State Public Health Laboratories;* and *Campaign Notes*, a leaflet published monthly, and distributed free to interested persons.—T. J. Putnam.

CANCER. *G. L. Howe,* Eastman Kodak Co., Medical Dept., Health Bulletin No. 37, Sept., 1918, 3 pp.—A leaflet for distribution to the employees of the Eastman Kodak Co., giving the simpler facts about the prevalence, symptoms, and possibility of cure by early operation, of cancer. "After the age of forty, the death rate of cancer is greater than that of either consumption or pneumonia, and of those persons who reach this age one in every eleven dies of this disease. . . . The signs mentioned below will always bear close investigation when they occur at this time of life.

"1. Loss of weight.

"2. Unusual pallor.

"3. Persistent disturbances or 'upsets' of the stomach or bowels.

"4. A wart or mole which shows a tendency to grow.

"5. The appearance of a lump anywhere in the body. It may prove to be only an abscess or some simple harmless tumor—a physician can usually tell. A lump in the breast should always be regarded with suspicion, especially when it appears after the age of forty."

This booklet is an excellent model for literature for distribution among employees. Statistics for use in such bulletins may be obtained from the American Society for the Control of Cancer, some of whose publications are reviewed above.—T. J. Putnam.

CENTRAL NERVOUS SYSTEM

CONCERNING THE RELATIVE FREQUENCY OF INSANITY IN CITY AND COUNTRY. *H. M. Swift.* Bulletin of the Massachusetts Commission on Mental Diseases, Oct., 1918, 2, No. 3, 190-193.—From the United States as a whole the number of admissions to state insane hospitals during the year 1910 was 86 per 100,000 population from cities and towns of more than 2500 inhabitants, against 41 per 100,000 from places of less than 2500. Environment must be blamed in part for the differences, although alcohol and syphilis are factors; but it is also probably true that the city tends to draw from the country the predisposed families.—G. E. Partridge.

BIBLIOGRAPHY OF FEEBLE-MINDEDNESS IN ITS SOCIAL ASPECTS. *L. W. Crafts.* Journal of Psycho-Aesthenics, Monograph Supplements, Mar., 1917, 1, No. 3, 73 pp.—Comprises 956 titles, and includes many articles directly or indirectly bearing upon questions of economics, industry and education.—G. E. Partridge.

INDUSTRIAL EFFICIENCY OF THE MORON. *G. Ordahl.* The Training School Bulletin, Feb., 1919, 15, No. 10, 145-153.—Large numbers of high-grade feeble-minded are now being discovered The study attempts to show the relative efficiency of the high-grade feeble-minded as compared with that of the normal adult working in the same factory at the same time. The work consisted mainly of peeling tomatoes for canning. The morons showed about 68 per cent. efficiency as compared with the normal women.—G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

ARSENIC INTOXICATION IN THE INDUSTRIES OF COAL AND ITS DERIVATIVES. *Ad. Bayet* and *Aug. Slosse.* Comptes rendus de l'académie des sciences, Mar. 31, 1919, 168, No. 13, 704-706.—Our researches started from an inquiry in a briquette factory because of a disease affecting the workers called "pitch disease" from the name of the tarry substance used to bind the coal dust.

Among other symptoms, exceptional frequency of cutaneous cancer was found, of a kind particu-

larly serious, and causing a mortality of 30 per cent. of the workers affected. The symptoms shown by the workmen were various, but it was possible for one of us, by minute clinical observations, to separate out from the multiplicity of morbid manifestations a group of symptoms, which on examination showed striking analogy with those of chronic arsenic poisoning. These symptoms were (1) pigmentary troubles consisting essentially in a general and diffuse hyperpigmentation of the skin (*melanodermie*), localized pigmentation and sometimes colorless spots; (2) inflammatory and atrophic changes in the skin which, coupled with the pigmentations, constitute a special condition of the skin (*l'état sclerodermique*) such as one finds in a senile skin and in the condition brought about by radium; (3) thickening of the skin, notably warts situated generally on the scrotum; (4) cutaneous cancer situated most frequently on the scrotum and neighboring parts. This frequently multiplies and appears at a relatively little advanced age. But these cardinal symptoms of pitch disease are found with others of essentially the same character in chronic arsenic poisoning, as described by Hutchinson. The secondary symptoms of importance are found also in chronic arsenical poisoning, and that down to the smallest details. There is thus striking identity between the symptoms of pitch disease and chronic arsenical poisoning, but such conclusion, based on clinical evidence alone, should be submitted to analytical tests. It was necessary to show that arsenic exists in the substances handled by the workers and then in their own bodies. These tests were made, taking the greatest precautions possible, the method used being that of Striszowsky. We can demonstrate the presence of arsenic:

1. In the pitch.
2. In the dust floating in the air of the factory.
3. In the hair of all the workers, and that in notable quantities.
4. In the urine of the workers.
5. In the blood of the majority of them.

As a proof, we tested the blood, hair and urine of other workers in the same district, but not working in briquette factories. They contained no arsenic. The conclusion to be drawn from these tests is that the workers in briquette factories are subjected to an obvious arsenical impregnation. The two methods of proof are thus seen to converge—clinical on the one hand, and chemical on the other. The symptoms observed, therefore, in individuals working in pitch, we may conclude, are those of chronic arsenical poisoning. But this question of chronic arsenical poisoning is not limited to briquette factories. Indeed, one finds in quite a series of trades using coal and its derivatives, a picture identical with that of pitch disease. The similarity is such that all who have occupied themselves with the question include them all in the same class; as, for example (1) chimney sweeps' cancer, characterized by melanoderma, warts commencing early, often multiplying and situated generally on the scrotum. With these must be classed workers packing soot and the class of arsenicism observed among the workers cleaning the inside of steam engines; (2) affections among workers distilling tar and those working in paraffin refineries; this malady also has as its principal symptoms melanoderma, hyperkeratoses, and cancer identical with that of pitch workers; (5) affections of asphalters, those tarring the railway lines, and workers making tar paper.

Arsenic found in soot, tar and its by-products comes originally from coal in which we have constantly found it. It has been known for a long time that there are coals rich in arseniferous pyrites, but one did not suspect that it was so generally true, nor that it could have such pathological consequences. We can thus say generally that there is a form of industrial arsenic intoxication, widespread, affecting a large number of workers, and having coal as its starting point.—T. M. Legge.

War Industrial Diseases. *Alice Hamilton.* Med. Rec., June 21, 1919, 95, No. 25, 1053-1059.—In August, 1914, there were many nitroglycerin plants, a sufficiency of gunpowder factories, only one small plant making T.N.T. on a small scale and a few plants making nitro cotton and smokeless powder. By 1916, forty to fifty plants were making explosives, and in forty-one of them 30,000 persons were employed in work which brought them in contact with some industrial poison. This excludes ordinary gunpowder, for no poisons are involved in its manufacture. Intoxication is produced by both inorganic and organic substances. Of the former, nitric acid is the most important, as it is used in the form of mixed acid in all nitration processes. All explosives, except gunpowder, are nitrated bodies. One hundred per cent. acid is used for higher nitrations. This is hard to control. It eats through almost any substance and causes leaks. The most important organic compounds are benzene, toluene and anilin.

In a first survey, 2432 cases of poisoning were discovered, seventy-five of which were in women. Among these were 111 cases of fulminate dermatitis, lasting from twenty-four to forty-eight hours; a mild anilin poisoning in 200 more, of the same duration; and 702 T.N.T. intoxications. There were thirteen deaths from T.N.T., twenty-eight from nitrous fumes, and seven (out of a total of fourteen cases) from benzene intoxication. The problem of protection against nitrous fumes was solved by 1918; whereas T.N.T., being less understood, proved to be a more difficult question.

A nitric acid explosion consists of an escape of fumes of the pale lower oxides of nitrogen and orange colored higher oxides. Tolerance of a dangerous amount of these fumes cannot be acquired. Death results from edema of the lungs. There is no more immunity from fume poisoning than from nitric acid burns on the skin. In nonfatal cases, laryngitis, with edema of the glottis, may develop, as well as erosion of the enamel of the teeth. The labor turnover was too great to permit the collection of data on the effect of breathing in small amounts over a long time.

In the manufacture of picric acid there is danger from nitrous fume poisoning, from the picric acid itself, from the phenol, and from the

exposure to benzene involved in the production of phenol for picric acid.

The manufacture of T.N.T. in America has been associated with much poisoning, in fact, with much more than in England. Seven hundred cases, of which thirteen were fatal, were encountered, and doubtless there were many more unreported cases and deaths. Hudson calls "minor T.N.T." that with symptoms as follows: bitter taste in the mouth, gastro-intestinal indigestion, constipation, rarely diarrhea; then, severe general malaise, headache, pain in the chest, vertigo, weakness in the limbs, lips cyanotic, the skin of the face yellowish. Old chronic cases, or those with repeated mild attacks, develop neuritis of the lower extremities. Some men complain also of a bad taste in the mouth, loss of appetite, persistent headache, nausea and cramps in the abdomen. Still others complain of cough, sore throat, tightness in the chest, running eyes and burning nose. As a usual thing the urine is darker in color. Such cases, with prompt eliminative treatment, recover rapidly; if neglected, however, they advance to a more serious stage.

In one case at autopsy, toxic hepatitis, tubular nephritis, secondary anemia and icterus were found; in another, aplastic anemia with secondary degeneration in the parenchymatous organs. Dr. T. H. Harrington of Boston describes several cases suggestive of poisoning by other compounds, because of the fatal rapidity of their course.

An investigation was conducted in June under the National Research Council with the following results: (1) It was concluded that, although not the only channel of absorption, the skin is by far the most important one. (Instances of fume poisoning purely are related, however.) (2) The younger men were found to be more susceptible. (3) No light was thrown on the subject either of sex or of race susceptibility, except that negroes are probably less susceptible than whites. (4) Urinary tests show rapid absorption of T.N.T., if exposure is great; and rapid elimination, if exposure is stopped. Hence the desirability of eight-hour shifts and one day's rest in seven.

The early symptoms are: short breath on exertion, dizziness on stooping over, headache, fatigue and poor appetite. These, with a positive Webster test, should lead to temporary shifting from T.N.T. work in order to avoid serious poisoning.

These studies in munition poisons may be of use in peace time industries, inasmuch as (1) the manufacture of nitric acid will go on; (2) picric acid is an important dye; (3) celluloid and films for moving pictures are made much the same as is nitro cotton; (4) T.N.T. may take the place of nitroglycerin for surface blasting. Many of the nitro compounds of the benzene ring, better understood than T.N.T., are now used in American dye works.—W. Herman.

TRINITROTOLUENE POISONING. *C. Voegtlin, C. W. Hooper*, and *J. M. Johnson*. U. S. Pub. Health Ser., Pub. Health Rep., June 13, 1919, 34, No. 24, 1307-1311.—Dogs were used for the experimental work, as they are more susceptible than rodents. The usual symptoms were cyanosis, constipation, followed by diarrhea, salivation, incoordination, icterus, and anemia. The cyanosis may disappear late in the poisoning. The drug is readily absorbed when administered subcutaneously in oil, by mouth, or as a dust into the lower air passages. The blood of poisoned animals may show a positive Webster test. The urine gives a positive Webster two or three hours after the drug is administered; but in a later stage of poisoning it may become negative, indicating, perhaps, an altered method of dealing with the chemical. The bile may give a Webster test, but the feces are always negative. The trinitrotoluene was administered over long periods of time in doses of from 5 to 33 mg. per kilo of body weight. The toxic dose is probably less than 180 mg. for an average adult man. Variations in susceptibility are marked. Susceptibility is increased by anemia or any infection. Dogs do not become immune, but certain symptoms, such as cyanosis and inco-ordination, may decrease or disappear during continued administration of the drug. No difference was observed between the action of purified trinitrotoluene and that of the crude material. A meat diet was found to have some prophylactic value. The usual blood changes were as follows: a reduction in the total blood volume, the blood corpuscle, the hemoglobin, and the pigment volume; the appearance of nucleated blood cells, and an increase in reticulated blood cells. Anisocytosis is common, especially at first. The red count is usually decreased, but seldom in proportion to the other blood changes. Among the important urinary findings is that of bile pigments in many cases, especially in those which later develop jaundice. Urine from poisoned dogs never contains more than traces of albumin, and the Fehling test is only slightly positive at times. The gross pathological findings are as follows: decrease of muscular tissue, degeneration of liver, decrease or increase in the size of the spleen, occasionally generalized jaundice. The bone marrow may be hyperplastic or fatty.

On the basis of this experimental work, and also of tests at a shell-filling factory, the authors make several practical suggestions. The hemoglobin of workers should be estimated by some good instrument, such as Sahli's, upon employment and at intervals of fourteen days thereafter. A decrease of 20 per cent. from the original figure should be a signal for the removal of the man from contact with the material. An examination of the urine for bile pigments should be made about as often; Huppert's or Rosenbach's test is recommended. Cyanosis and incoordination are suggestive physical signs. Workers showing an abnormal susceptibility should be eliminated.

It is suggested that trinitrotoluene workers eat at least 150 gm. of meat daily. The skin is probably the chief path of absorption, although considerable amounts may also be inhaled. To prevent skin absorption, a varnish made of 1 part of shellac dissolved in 24 parts of warm 95 per cent. alcohol, to which 1 part of castor oil is then added, may be used on the hands. A similar varnish for cotton gloves may be made of 2 parts shellac, 1 part castor oil, and 8 parts alcohol. These varnishes may be washed off with alcohol Workers should be made to wash their hands in 10 per cent. solution of sodium sulphite at the

end of the day. Workers with anemia or any symptoms indicating lowered body resistance should be excluded.

The detailed report will appear in the near future as a Hygienic Laboratory Bulletin.—T. J. Putnam.

Gas Mask Absorbents. *A. B. Lamb, R. E. Wilson,* and *N. K. Chaney.* Jour. Indust. and Engin. Chem., May, 1919, 11, No. 5, 420-438.—The new absorbent for the American army masks, consisting of 75 per cent. specially impregnated charcoal and 25 per cent. of soda-lime without permanganate, is the best all-around absorbent available. The requirements for a gas-mask absorbent are: absorptive activity, or a high rate of absorption; absorptive capacity; versatility; mechanical strength; chemical stability; low breathing resistance; ease and cheapness of manufacture; and proper balance of ingredients to produce and preserve the other properties under varying conditions. The average air velocity through the army canister is about 80 cm. per second. The absorbent must be capable of reducing the concentration of a gas from 1000 p.p.m. to 1 p.p.m. or less, in about 0.01 second. It must further be able to hold this absorbed gas permanently. The standard test for absorbents is the accelerated chlorpicrin test, which consists in passing a stream of dry air containing 7000 p.p.m. of chlorpicrin, at the rate of 1000 cc. per sq. cm. through a 10 cm. layer of the absorbent, until the first trace begins to come through. The last two months' product of the service absorbent gave a material averaging fifty minutes on this test. The authors discuss at length the various sources of charcoal, and the best methods of activating it —that is, of increasing the amount of active capillary surface which it contains. They also mention the effect of various external conditions upon the finished product. The special soda-lime, the composition of which is also detailed with special reference to its industrial possibilities, contained hydrated lime, cement, kieselguhr, and sodium hydroxide.—T. J. Putnam.

DUST HAZARDS AND THEIR EFFECTS

The Dust Hazard in the Abrasive Industry. *C.-E. A. Winslow, Leonard Greenburg,* and *D. Greenberg.* U. S. Pub. Health Ser., Pub. Health Rep., 34, No. 22, 1171-1187.—Two studies of tuberculosis have been made in the United States, from the standpoint of age and industry. These studies disclose the fact that in trades involving exposure to mineral and metallic dust the ratio of tuberculosis is one-third higher than that for all occupied males. Dusty trades involving small, sharp, non-absorptive particles are by experiment found to be the most hazardous. The manufacture of abrasive materials is one of the most hazardous occupations. The inorganic particles of fused aluminum compounds and of carborundum are very hard, angular and sharp. Sample photomicrographs are shown and the results of a study in two abrasive factories are given in detail.

The first factory, in which both the carborundum and finished wheels are made, had few protective measures against dust. In one grinding room the exhaust system in operation was grossly inadequate on account of poor design and poorer maintenance. Of thirty-eight samples of air taken in work rooms the average number of ¼ standard particles was 31,000,000 per cubic foot of air as against a maximum of 300,000 for a good polishing shop (Winslow, Greenburg and Angermyer). The air in the offices and yards of this factory was found to be very high in dust content.

A study of the second factory, in which only the abrasive material is prepared, showed a much greater dust pollution of both outdoor and indoor air. In this factory one sample taken in a coke grinding room gave the startling number of 669,000,000 ¼ standard particles per cubic foot of air.

The two factories noted above had the highest dust count of any yet reported by any investigator.—E. H. Reeves.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Agricultural and Industrial Community for Arrested Cases of Tuberculosis and Their Families. *H. A. Pattison.* Federal Board for Vocational Education, June, 1919, Bull. No. 32, Reeducation Series No. 6, 45 pp.—The condition of patients who have undergone treatment for tuberculosis in sanatoria has been the subject of extensive investigation during the past ten years, with the view to determining their condition on discharge, as compared with their condition within a certain number of years after discharge. There is overwhelming evidence to show the need of developing some adequate system of post-sanatorium treatment. The solution to this problem lies in the formation of some sort of "colony." Such a "colony," however, must not be purely agricultural, but must include diversified occupations of an industrial nature in order to fit better the physical and intellectual demands of all types of men and women. Suggestions and plans to this end are herein discussed.—L. A. Shaw.

The Management of Venereal Diseases by the U. S. War Department During the Past Two Years. *E. L. Keys, Jr.* Pub. Health Jour., June, 1919, 10, No. 6, 253-261.—A review of the methods employed and the results obtained in the control of venereal disease by the U. S. Army during the past two years comprised under the following sections: Pre-War Conditions; The

Anti-Venereal War Campaign; Incidence of Venereal Diseases in the Civil Population; Incidence of Venereal Diseases Before and After Enlistment; Social Hygiene and Medical Prophylaxis; The Future.—L. A. Shaw.

IS EDUCATION A WORTH-WHILE FACTOR IN THE CONTROL OF VENEREAL DISEASES? *H. E. Kleinschmidt.* Social Hygiene, April, 1919, 5, No. 2, 227-231.—Statistics show that during the eight years previous to the war, venereal diseases in the Navy existed at the rate of 165 per 1000; whereas during the period, July 1, 1918, to Dec. 31, 1918, the rate declined to 74 per 1000. The causes of this improvement are attributed to: (a) a better class of men entering the Navy since the war began; (b) placing sailors on a higher plane of public esteem; (c) closing the bawdy house and saloon to the sailor; (d) provision of recreation and entertainment; (e) activities of health authorities in removing carriers of infection; (f) educational propaganda. Especial stress is laid upon the necessity for a vigorous campaign of educational prophylaxis to accompany medical prophylaxis.—L. A. Shaw.

PREVENTIVE PROPHYLAXIS FOR VENEREAL DISEASES. Editorial, California State Board of Health, Month. Bull., May, 1919, 14, No. 11, 368.—The principles which must underlie the suppression of venereal diseases are:

1. The separation of the moral from the medical problem.
2. The realization of the fact that fear of disease is no deterrent to immorality.
3. The conviction that venereal diseases can be eliminated with great certainty.—L. A. Shaw.

PHYSICIANS HELP IN VENEREAL DISEASE FIGHT. Editorial, California State Board of Health, Month. Bull., May, 1919, 14, No. 11, 368.—Nearly 300 physicians in California have pledged their co-operation in the program for venereal disease control, by agreeing:

1. To report all cases in accordance with the California State Board of Health regulations.
2. To secure prompt treatment of all cases coming under observation.
3. Not to dispense medicines in venereal disease cases, and not to recommend self-treatment remedies.
4. To give out circulars furnished by the U. S. Public Health Service and state boards.—L. A. Shaw.

AN ACT TO PREVENT THE SPREADING OF VENEREAL DISEASES. Public Health, Michigan Dept. of Health, July, 1919, 8, No. 7, 296-299.—The Michigan State Department of Health is authorized to adopt rules to prevent the spreading of venereal diseases, to facilitate proper treatment thereof, to regulate isolation of infected persons, to disseminate information to the public, to provide for treatment of cases in proper institutions, to regulate the routine of physicians and of institutions treating said diseases, etc.—L. A. Shaw.

UNLAWFUL TO ADVERTISE VENEREAL DISEASE REMEDIES. Editorial, California State Board of Health, Month. Bull., May, 1919, 14, No. 11, 369. —A law has been passed in California, prohibiting any person or association, except boards of health, from circulating any printed matter concerning venereal diseases, self-abuse, or sexual indulgence; or any medicines or device that may be used therefor.—L. A. Shaw.

WISE LEGISLATION. Conn. Health Bull., March, 1919, 33, No. 3, 3.—A bill has been passed in Connecticut prohibiting motion pictures on the subject of venereal diseases without a permit from the Commissioner of Health. The purpose is to prevent the commercial exploitation of vice. Intelligent enlightenment, however, is being encouraged with success through exhibitions to men and women separately with short explanatory lectures.—L. A. Shaw.

SANITARY SERVICE RIDS CONSTRUCTION CAMP OF INFLUENZA. *M. D. Kauffman.* Engin. N.-Rec., Mar. 27, 1919, 82, No. 12, 622.—During the height of the influenza epidemic last autumn the construction force building the extension to Camp Custer suffered no diminution on account of disease. Instead, the superior reputation for healthfulness led to an increase of 50 per cent. in the applications for work, when surrounding communities were decimated by the disease. There were only four cases of influenza among a working force of up to 1200 men. No unusual hygienic measure was adopted, but no essential sanitary precaution was neglected, from scrupulous inspection of the men's personal hygiene, to street-cleaning. All but a few of the employees cooperated most cheerfully. The details of the measures adopted are given by the author.—T. J. Putnam.

MALARIA CONTROL AT NITRATE PLANT. *W. G. Stromquist,* Engin. N.-Rec., April 10, 1919, 82, No. 15, 718-720.—Mosquito-eradication measures were carried out over an area of about 60 square miles at Sheffield, Ala., under exceptionally difficult circumstances of labor and locality. Drainage by vertical shafts and ditches, and systematic oiling of ponds and marshes, controlled by inspection for larvae, were the most important features of the work. The cost per square mile was approximately $1,200. Malaria was reduced about 90 per cent.—T. J. Putnam.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

AN ANALYSIS OF TWO HUNDRED AND SIXTEEN INDUSTRIAL ACCIDENTS. *Carl Scheffel.* Med. Rec., April 26, 1919, 95, No. 17, 685-687.—This list of accidents is taken from a plant in which the average number of industrial accidents may well be compared with that of other plants in the same line of industry. Only those accidents which were severe enough to cause loss of time from work are

considered. Males and females were employed in equal number, ranging from 16 to 60 years of age, with 21.6 years as the average. Of 216 accidents, 79 were unavoidable, 111 were due to carelessness, and 26 were due to negligence of fellow employees. It is suggested that with further study some of the 111 accidents, which were due to carelessness, might be eliminated.

A chart is given showing the frequency of accidents at various hours of the day. The plant runs from 7.30 A. M. to 12.30 P. M. and from 1.30 P. M. to 5.30 P. M. In the forenoon the crest of the wave is reached between 8 and 9 o'clock, with a gradual diminution until noon. In the afternoon the highest number of accidents occurs between 1.30 and 2.30. The logical conclusion to be drawn from this chart is that the factor of fatigue may be eliminated, whereas the greater prevalence in the early morning and in the first hour after lunch indicates the factor of "getting warmed up" as an important one. This being the case, rest periods of five to ten minutes, as practised in some plants, may be a danger rather than a desirable preventive measure.

In a chart showing prevalence of accidents by the month, the height of the curve is reached during September and October. Had fatigue been a factor, would not July and August have been more likely?

Chart IV shows the part of the body affected, and demonstrates that palmar injuries are more susceptible to sepsis than any other injuries of the hand.

From Chart V it is learned that new and untried employees suffer more accidents than experienced ones. Employees require at least six months' experience in this industry before they cease to be industrial accident risks above those of the average older employees.—W. Herman.

Reducing Accident Risk Section. Factory, June, 1919, 22, No. 6, 1380-1382.—Brief comments on "Using Safety Stations" and "Keeping Interest [in safety] at a High Pitch."—C. H. Paull.

An Investigation of Stenches and Odors for Industrial Purposes. *V. C. Allison* and *S. H. Katz*, Jour. Indust. and Engin. Chem., April, 1919, 11, No. 4, 336-338.—The Bureau of Mines has recently made an investigation of the use of stenches as a warning in mines. Other uses of stenches are testing boilers and pipes, and mixing with water gas to indicate leaks. An apparatus, or "odorometer" was developed for measuring the intensity of odors in varying concentrations in air. The odors of twenty-four different chemicals were examined with this apparatus, and the results of the tests are tabulated by the authors. —T. J. Putnam.

INDUSTRIAL SURGERY

Stiff Fingers: With Special Reference to Methods of Treatment by Metal and Plaster Splints. *P. J. Verrall.* Jour. Orthop. Surg., June, 1919, 1, No. 6, 335-343.—The author considers the problem entirely aside from any treatment of the primary cause of the disability. He illustrates his methods of treatment in the following types of cases:

A. Fingers flexed when wrist is dorsiflexed: extension possible with wrist flexed. He applies splints on flexor surface leaving each joint in deformed position until all distal joints have first been corrected.

B. Wrist movement free: one or more fingers flexed at all three joints, contraction unaffected by position of wrist. For this he has devised a special splint to secure gradual extension without losing the flexion.

C. Free movement at the metacarpo-phalangeal joints: two distal joints flexed. Usually small palmar gutter splints are enough.

D. Metacarpo-phalangeal joints stiff in hyperextension: distal joints straight or slightly flexed. In this type the cause must be treated first, if possible, *viz.*, excision of scars, freeing of tendons, tendon grafting. Here the greatest difficulty, that of getting the joint over the "dead center," can be overcome by using a type of cock-up splint that the author has modified from the original type of Sir Robert Jones, so that he can exert flexion on the fingers in combination with dorsi-flexion of the wrist.—C. C. Lund.

NUTRITION AND METABOLISM

The Problem of Malnutrition in School Children. *L. A. Averill.* The American Journal of School Hygiene, March, 1919, 3, No. 1, 1-24.—This article contains new data, reviews and bibliography and deals with the subjects of injurious beverages and malnutrition. As a people, Americans undoubtedly consume too great amounts of carbohydrate foods.—G. E. Partridge.

WOMEN AND CHILDREN IN INDUSTRY

Peace Time Standards for Women in Industry. U. S. Employment Service Bulletin, Dec. 17, 1918. Printed in America. Physical Education Review, Feb., 1919, 24, No. 2, 115-116.—A

brief but valuable set of regulations in regard to hours of labor, holidays, periods of rest, wages, comfort and sanitation, posture at work, safety, selection of occupations, prohibited occupations, uniforms.—G. E. Partridge.

HANDLING WOMEN WORKERS SECTION. Factory, June, 1919, 22, No. 6, 1342-1348.—Comments on "Women on Safety Committees," and "How Better Surroundings Help."—C. H. Paull.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

STUDIES OF THE MEDICAL AND SURGICAL CARE OF INDUSTRIAL WORKERS. *C. D. Selby*, U. S. Pub. Health Ser., Pub. Health Bul. No. 99.—This bulletin, prepared by order of the Surgeon-General, is the result of a survey of the efforts being made throughout the country to deal with the problems of injury and disease in industry. Conditions found are described, tabulated and discussed, and various criticisms and recommendations are made by the author. The pamphlet is, perhaps, especially intended to serve as a guide to factory managers who are contemplating the establishment or amplification of a medical department. The following long abstract consists largely of direct quotations from the bulletin itself:

"One hundred and seventy industrial establishments, variously located in the Eastern and Middle Western States, were visited during the first six months of 1918 for the purpose of studying their medical and surgical facilities for the care of workers. . . . The report which follows is based upon analyses of these data and also upon observations and opinions obtained in these visits. In it are considered the personnel, equipment, activities, methods, and record forms necessary to the care and relief of sick and injured industrial workers and the prevention of sickness among them. Existing conditions relative to the organization, management, and operation of industrial medical departments are described, and standards or ideals which have been suggested by analyses and observations are proposed.

ACTIVITIES OF INDUSTRIAL PHYSICIANS

"Industrial medicine may be defined as the theory and practice of medicine applied to the purpose of preventing and alleviating sickness and injury among industrial workers in order that they may enjoy the benefits of continuous productive employment. It embraces a wide range of medical activities, including sanitation and preventive medicine, diagnostics, internal medicine, emergency and orthopedic surgery, roentgenology, laboratory technic and interpretation, orthodontia, dental prophylaxis, the well-known specialties of the eye, ear, nose, and throat, and other branches of practice.

"Although fundamentally the science of medicine, the position which industrial medicine occupies is similar to that of employment, safety, and compensation. All are specialties in the science of industrial management. Physicians who do not understand this relationship (and medical training does not necessarily contribute to this understanding) have reluctance in accepting the materialistic viewpoints of employers and, conversely, have difficulty in persuading employers to accept their professional points of view.

"Physicians and employers both must realize that industrial medicine is, in a measure, a compromise between the ideals of medicine and the necessities of business. In approaching the compromise this fact should not be overlooked, that medical service in the industries to be of the greatest possible usefulness must benefit primarily the working people. The benefit to industry naturally follows.

"Industrial establishments exist solely for manufacturing purposes, and the basis of their prosperity is the materials or products they manufacture. Production . . . is of the highest order of importance. . . . Anything which is capable of facilitating production is welcome to industry so long as its cost is not excessive. The test is its ability to increase the quantity or to reduce the cost of production without impairing the quality. . . . On the contrary, anything that retards or does not facilitate production is tolerated by industry only so long as it is unavoidable. Accidental injuries are such. By incapacitating the worker, they retard production. Always necessitating surgical treatment, frequently the payment of compensation, and occasionally the substitution of unskilled labor, they are sources of expense. . . . Exigent, humane, and economic reasons force them [employers] to accept and endure the burden of surgical service as a penalty for accidents which industry does not seem able wholly to prevent.

"For the influence which industrial medicine may have upon lost time, labor turnover, etc., it has a strong appeal to employers, but little to the people who work for them. To be fully acceptable, it must supply needs in the industrial lives of both, and those needs must concern the matter of production, for which industry exists.

"Employers and employees are associated in industry because each has something the other needs and both are willing to exchange; the employers their money for labor and the employees their labor for money. In agreeing to an exchange the employers naturally desire as much labor as they can obtain for their money (maximum production at minimum cost) and the employees wish as much money as they can obtain for their labor (minimum production at maximum cost). To complete the bargain a compromise is unavoidable, and although the terms may not be evident they are in substance that the employers agree to pay more and the employees agree to labor more (produce more). The latter action only is relevant to the analysis.

"Being the party of the first part, the employers assume leadership and either try to com-

pel or to assist the employees to live up to their concurrence. If their method is compulsion they are likely to accept their employees as they come, with little or no discrimination, oblige them through stringent supervision or inspire them by premiums, bonuses, and extra pay for overtime to work faster and longer, either or both, and retain them, if they stay, only so long as they are able to meet the requirements for production. This method conduces to exhaustion of the workers, carelessness among them, neglect of their health (sickness), and their safety (injury). It is prolific in spoilage and wastage of output, breakage of tools and equipment, and idleness of machinery. It provokes lost time and labor turnover. For the employers the final results are lessened production and increased cost; they do not want them. For the employees they are lessened ability to produce and reduced pay; nor do they want them.

"If the policy of the employers is to assist their working people to greater production, they do so by selecting them with consideration of their fitness for the work they are expected to do, helping them to be regular, dependable, and efficient, and aiding them constantly to increase their value.

"The results that employers may expect from these activities are more of contentment and feelings of goodwill among their employees, greater stability and efficiency in their working forces, maximum of production and relatively low labor costs—results that are beneficial to their employees and society as well as themselves. . . . The ability of physicians to participate in this program establishes the logical relation of medicine to industry."

The industrial physician can chiefly aid the employer to give his workers the opportunity for maximum production along the following lines:

1. *By providing safe, healthy places to work in.*—The custom of a medical inspection of plants, in addition to inspection by the safety engineer, should be more widely followed. The inspections should be at stated periods, and should be made in company with some members of the safety department, if convenient. "Observations should be made to include the premises as well as the buildings and to concern sewage and waste disposal, washing and toilet facilities, ventilating, illuminating and heating or cooling systems, blowers, suction devices, sweeping and cuspidor services, etc. Drinking waters should be examined frequently, unless the sources are unquestionable. Installations for regulating the temperature of drinking waters should be checked up occasionally by temperature tests at the faucets.

"2. [*By providing*] *machinery, tools, methods and processes which permit rapid work of good quality, with health and body hazards reduced to the minimum.*—There are hazards connected with the use of machinery and tools, but they are more evidently hazards to the body than to health. Their reduction to the possible minimum is a matter chiefly for mechanical consideration. . . . Physicians are drawn into the accident problem after the damages have been done, and their relations are apt to be, in the eyes of the management, on a parity with that of a wrecking crew, necessary, but not desirable. They may . . . assist in the prevention of accidents by making available the information they are able to obtain directly from the injured people. This and information obtained from other sources . . . enable the safety engineers to analyze accidents and injuries individually and in series for the determination of their causes. Seemingly with this in mind, a number of medical departments studied make one or more carbon copies of their reports of injuries, and these are sent to safety, compensation, and such other departments as are interested . . . It may be mentioned that there is a relation between physical defects and accidents. . . .

"Mechanical operations possess also hazards to health, which are, of course, less apparent to safety men than to physicians. They are those operations that are monotonous, concentrating, or exhausting, capable of being done easily by some types of people, but full of menace to the health of others. In this connection, likewise, a full knowledge of the physical and temperamental limitations of employees is of much assistance to employing departments, and of great benefit to the operatives themselves. Researches into the physiological effects of fatiguing and enervating operations may permit physicians to cooperate in the selection of qualified workers for the monotonous, concentrating, and exhausting jobs, and incidentally will serve to elevate the practice of industrial medicine to a higher scientific level.

"Certain industrial processes require the use of chemicals that are known to be inimical to health. Certain others cause fumes, gases, and dusts which may be harmful or may be only disagreeable or irritating. Under what circumstances and conditions people may engage in these processes with reasonable safety and effort is a valuable study for the practitioners of industrial medicine, in the pursuit of which they may find many excellent sources of information among the older process workers, upon whom experience has bestowed a wisdom that does not appear in books on occupational diseases. Before attempting to advise in these matters physicians should seek the confidence of the workers by becoming familiar with the processes they use, and they should remember always that these people are experts and are to be treated as such lest the contempt which a professional has for an officious amateur be aroused in their minds.

"3. [By] *competent supervision.*—Industrial physicians meet with many opportunities to clear up differences between employers and their employees. By successfully availing themselves of these opportunities, they are able to foster the feeling of goodwill which is so essential to competent supervision. In seeking to do so they should betray no confidences and at all times should be fair.

"Industrial managements endeavor also to acquire knowledge of the productive capacities and limitations of their operatives, without which they may overwork some and underwork others. The information obtained by physicians through physical examinations permits them to supplement the technical knowledge of the employers

and jointly they are able to distribute equitably the work to be done.

"4. [*By providing*] *the organizations and equipment necessary to ascertain the kind of work applicants for employment are temperamentally, physically, and by training fitted to perform.*—It is reasonable that employers should strive in their selection from applicants for employment to choose only such as may appear adapted to perform the work for which help happens to be needed. With this object in view, applicants are examined in various ways to determine their qualifications, and physical fitness is an important qualification to be considered. As might be expected, this part of the examination is delegated to physicians. Such is the arrangement in 69 of the industrial medical departments studied; the other establishments, at the time of the study, did not require physical examinations.

"The selection of qualified employees implies the rejection of disqualified applicants. . . . Although there was a variance of opinion as to what should be deemed just causes for rejection, these conditions were usually mentioned: Heart and kidney lesions, hernia, varicocele, hydrocele, varicosed veins and ulcers, deformities which impair function, deafness, imperfect vision, and the communicable diseases. There can be no question about the communicable diseases, but unless the principal reason for the rejection of impaired applicants is frankly to obviate the possibility of being forced to compensate them for incapacities of disputed origins or severities, it would seem that physicians who are familiar with working conditions in their establishments could assist in the assignment of a large proportion of the physically defective and by subsequent supervision aid them to do their work well. On the conviction that this is good business, a few officials asserted that the presence of a communicable disease was their only cause for rejection. This is the policy of a storage-battery company of Philadelphia, which company has a department manned by mutes. Two blind men were found in the plant of a large electric motor company at Springfield, Ohio. Fifty-one crippled employees were reported at an Ohio shoe factory.

"6. [*By*] *physical supervision.*—To direct the health affairs of employees competently, physicians should reexamine them with sufficient frequency and thoroughness to be at all times familiar with their conditions of health. How often these reexaminations should be made depends somewhat upon the conditions of the individuals and the circumstances under which they labor. Process workers whose health is subjected to special hazards should be reexamined at least monthly, as required by law in some states. Employees who do not feel well or have the appearance of illness should be examined; also those whose output becomes less than usual, except for reasons that are evidently not physical. Pathological conditions known to exist should be checked up by occasional observations. In justice to both employers and employees, process workers should be examined before being permitted to leave the services of their companies, as is done at a large storage-battery company in Ohio. Employees who have been incapacitated by illness or injury should be examined before reassignment to work. Workers who apply for reemployment should be caused to pass through the same routine as new applicants.

"7. [*By providing*] *protection from the communicable diseases.*—While it may not be possible for doctors to visit personally all employees each morning, it should be understood among foremen and workmen that any person who has a breaking out, or who does not feel well, must report for diagnosis, and treatment if necessary. . . .

"8. [*By providing*] *medical, surgical, and dental treatments when responsible for the conditions requiring such treatment.*—Laws have made employers responsible for injuries, and in some instances for specified diseases which workmen incur during and because of their employment. . . . The chief function of industrial physicians in this connection is to assist sick and injured employees to recover as nearly as possible their normal conditions of health or body with as little loss of time as is consistent with satisfactory progress.

"9. [*By*] *medical and dental prophylaxis.*—This is health instruction by practical demonstrations applied in the treatment of those trivial ailments for the relief of which people rarely seek professional advice. They are those ailments which occur among industrial workers, as well as others, through neglect of their bodies; as, for instance, headaches, constipation, bad teeth, etc. This activity has been proven particularly effective in showing the working people how to care for their teeth, which they seem almost universally to neglect.

"10. [*By providing*] *proper nourishment, at cost or otherwise, during the working day.*—To obviate the bad effects of a cold lunch washed down by cold water, or the bolted meal after a hurried trip home, employers are coming more and more to provide restaurants or cafeterias, where their employees may secure good food at moderate prices. They are also setting up stations from which milk, coffee, or soup may be distributed for morning or afternoon refreshments. For luncheons, physicians are in a position to suggest menus that are adapted to the needs of the employees. Through cooperation with the health officials they are able to assist in the selection of safe food and milk supplies. They may exercise supervision over the sanitation of the kitchens and watch for the presence of transmissible diseases among the food handlers.

"11. [*By providing*] *time and facilities for rest and recuperation.*—Many establishments have rest rooms for the use of their employees, especially those in which women are engaged. . . . Which employees need rest or exercise, when they should have it and for how long a period, and if it be exercise, what kind is required, are proper questions for industrial physicians to decide.

"A few concerns have country clubs or sanatoriums where rundown people may be placed for restoration. To whom this privilege should be extended and the conditions under which the restoration periods should be spent are also questions for the doctors to decide.

"12. [*By*] *instructions in how to keep well and*

avoid injuries.—The safety-first movement has impressed employers with the value of instruction in the prevention of accidents. They perceive also the value of instruction in the prevention of sickness, and they must rely upon physicians to conduct the instruction. Whether it should be imparted by personal talks, lectures, bulletins, or otherwise depends upon circumstances and the personality of the physicians. Certainly this is a field that is rich in opportunities for preventive medicine.

"13. [*By providing*] *opportunities for education and advancement.*—Special courses planned to prepare industrial workers for advancement are being offered and are proving popular. These give physicians excellent openings to impress ambitious workmen with the value of their health, especially in its relation to their abilities to advance to better jobs and hold them.

"14. [*By giving*] *assistance in adjusting social and financial difficulties.*—There is a tangible relation between the home and community lives of working people and their industrial efficiency. . . . While listening to other folks' troubles is not a function of medicine it has become an obligation to physicians whether in home or factory; it is a tribute the whole world pays the doctor. Thus it is that the physician is the one person in the industrial organization to whom the workers may feel inclined to go with their troubles. Because of this feeling toward them, doctors have opportunities to help employees as no employers can, and chances to gain for the latter the goodwill they so much desire and find is otherwise difficult to obtain.

"15. [*By*] *the encouragement of thrift, domesticity, morality, and sobriety.* — These qualities tend to prevent the occurrence of social and financial problems among the workers; and their absence often leads to problems of health."

RELATIONS OF MEDICAL DEPARTMENTS TO INDUSTRIAL ORGANIZATIONS

The physician in an industrial plant derives his authority from any one of a large number of sources. The various departments to which physicians were attached in the plants investigated are tabulated by the author as follows:

Production (superintendent or works manager, director of production)	71
Compensation (legal, compensation, or claims departments, treasurer, secretary-treasurer, auditor, clerks)	36
Administration (president, general manager, director of plant administration)	31
Labor relations (director of welfare, employment manager, service department, relief department, industrial service manager, paymaster, employment and welfare manager, safety, compensation and hospital department, relief, surgery, and employment department, and department of industrial relations)	28
Miscellaneous (office manager, safety department, and engineer)	4

"Two instances were noted of doctors who gradually expanded their activities until one is now in charge of an employees' service department, his own creation, and the other is directing an employment department, so called, which has the duties of a service or welfare department, also of his creation.

"It appears that 42 per cent. of the medical departments visited are responsible to officers who have supervision over production, 21 per cent. to officers who compensate for injuries, 18 per cent. to administrative officers, and 15 per cent. to those who direct employment and labor relations.

"The position a medical department should occupy in an industrial organization would seem to depend upon the purpose for which it is used. If the purpose is to facilitate production, it should be responsible to the superintendent or such other officer as has direct charge of production. If the medical service is mainly expected to reduce claims for compensation, it should derive its authority from the officer who handles the claims. If the object is to assist in stabilizing the laboring forces, it should be answerable to the officer whose duty that is. If the purpose of the medical department is broad and includes activities that concern several or all of the functions which are necessary to manufacturing, it should be accountable to the directing head only."

Tables are given, showing the provisions made for medical service in the plants visited, arranged in groups according to the number of employees engaged in the plant, from 500 to 10,000. Each table is analyzed separately.

"In reviewing these tables for the purpose of definitely answering the questions that inspired the making of the analyses, the dominant impression is that standards of neither time nor personnel can be fixed. . . . The work that the doctors or their departments do is the real determining factor. As part-time service is, with few exceptions, limited service, employers who wish their working people to have the benefits of unlimited medical attention must engage physicians capable of rendering or directing such and must give them time and opportunities to do so, leaving the determination of the conditions under which they may work largely to the doctors themselves."

THE SELECTION OF INDUSTRIAL PHYSICIANS

"Beyond the fact that industrial medical departments may or should consist of doctors, attendants, and clerks, personnel is also far from being standardized. The probable reason is that industrial medical service itself is not yet standardized, an opinion which is supported by the variance in the activities of the doctors of the different establishments. The treatment of trivial injuries, for instance, is the only one that is common to all. If that were the extent of industrial medical service, standards of personnel could possibly be fixed, with the accident frequency and severity rates as the basis. But there are other activities, and the more of them a medical department undertakes the larger the personnel must be. Even so, other factors enter into the problem. Consider physical examination of new employees for illustration. Here the number of doctors depends upon the thoroughness of their examinations, their ability to systematize and do the work rapidly, and the labor turnover,

which varies greatly in different establishments. Personnel depends then, chiefly upon the abilities of the doctors to create demands for the services of their departments and their capacities to organize and direct their departments in the service of these demands.

"The final conclusion in this, as also in the attempt to fix time standards, is that employers must engage capable physicians and allow them to secure assistants in such number and variety as they may deem necessary properly to carry on their work. If employers do not feel that they can leave these decisions to their doctors they may be assured that they have engaged the wrong physicians.

"When choosing physicians employers should exercise the same care they use in selecting men for other important positions in their executive organizations, and under no circumstances should they assume that physicians, because they are physicians, are thereby qualified to direct industrial medical departments. . . . Nor should they expect obstetricians, general practitioners, or even surgeons to make good in industrial medicine unless they have adaptability, latent capacity of administration, and plenty of time and opportunities to orient themselves.

"Employers should consider that two types of mind are needed for industrial medical service—one capable of expressing policies and able to organize the staff and direct the work, the other competent in details and qualified to do the routine. . . . Being trained in details, which the practice of medicine essentially is, physicians are apt to be of the latter type. . . . If the qualities that make a good executive are inherent in them, those qualities are likely to have been stifled; at any rate, medical training and experience do not tend to their development.

"To be sure, some physicians are endowed with administrative capacity which refuses to be stifled. By surrounding themselves with skillful assistants and directing their efforts wisely they become successful and usually prominent in their profession. This is the kind of physician that is most able to direct industrial medical departments, and employers would do well to select this type when in need of the services of chief physicians. . . . . It may be well for physicians first entering industrial medicine to visit several well-known industrial clinics to study existing practices, and certainly, before being expected to take charge, they should have time to familiarize themselves with their own establishments.

"To secure competent physicians for places where only one doctor is needed, with possibly one nurse or other aid, is exceedingly difficult, as the duties are such as to require the exercise of initiative as well as attention to the details of routine work, including the keeping of records and the making of reports, matters in which doctors are notoriously neglectful. . . .

"It is best to secure for these positions, if possible, doctors who have acted as assistants in established industrial medical departments and, while there, have shown talent for management. This also applies to the choice of chief physicians for those departments in which the executives are expected to do part of the routine work, the size of the establishments necessitating the employment of several doctors but not justifying the devotion of one man's whole time to administration.

"Parenthetically it may be suggested that the development of industrial medicine may be furthered by the affiliation of medical colleges with competent industrial medical departments, in order that graduates who incline to industrial work may secure actual training and experience in that direction as a part of the intern period.

"There will be places for routine workers in the medical service of industry, but their opportunities for employment must be limited chiefly to large medical departments and to association with physicians who provide medical service to numbers of small establishments. . . .

"In its formative stage, industrial medicine was purely an emergency service. Trivial injuries were either ignored or treated by fellow workmen. Others were sent to hospitals or the offices of physicians. . . . This plan, which is still in vogue in 14 per cent. of the establishments studied, has certain disadvantages, relating chiefly to lost time, which are as follows:

"1. The untreated or poorly treated trivial injuries are prone to develop infections resulting in prolonged incapacity and more or less permanent deformity.

"2. The time elapsing between the occurrence of serious accidents and the proper treatment of the injuries is frequently unnecessarily long.

"3. The time required for trips to doctors' offices in non-incapacitating injuries is time lost to industry.

"4. Employees who must go to the doctors' offices for redressings are inclined to lay off from work so long as dressings are necessary.

"5. The physicians are not close enough to the industries to realize the cost of lost time, and are therefore inclined to let the injured employees themselves fix their disability periods.

"6. The physicians cannot be of much assistance in fitting partially incapacitated employees for work which they may be capable of doing."

In some establishments dispensaries are provided, under the charge of a nurse, for the treatment of minor surgical injuries and medical ailments. This may be apparently more economical than having a full-time doctor, but the care of small injuries is but a small part of the usefulness of the industrial physician. Moreover, a legal question arises: are not these unlicensed attendants practicing medicine?

The decision between a whole-time physician or a part-time one is often difficult. The chief advantage of the part-time doctor seems to be that he is constantly in contact with his private practice, and so is, perhaps, a broader medical man. On the other hand, his mind is more likely to be divided between his work at the plant and his office practice. The scope of medical service rendered by full-time physicians seems almost always to be broader than that given by part-time men in the plants studied. Sixty-five per cent. of the doctors employed devote all their time to the work of the plant.

The difficulties of estimating the income of industrial physicians were numerous. It was almost always a matter of individual bargaining, ap-

parently, and the agreements were of various sorts. On the whole, the physicians rendering service only on request are paid better proportionately than those who are in regular attendance, and part-time physicians receive more proportionately than whole-time, perhaps because they are ready to accept less for a permanent, steady position; or because they are doing work which the employer regards as on a parity with that of a nurse—and too often the employer is right; the physician is no more than a "finger-wrapper," and does no constructive medical work.

Assistants.—The most common medical attendants, other than doctors, are female nurses. Occasionally a male attendant is found, but he is usually a clerk or a janitor who has picked up the elements of first-aid and nursing. Other departments of the factory are occasionally made use of in preparing supplies. In one establishment, for instance, the chemical department makes up Dakin's solution as required, at a considerable saving.

The industrial nurse often conducts classes in hygiene, or keeps the records and does other parts of the medical work for which she is qualified. In some localities, the nurses also visit employees who are absent on account of sickness, and sometimes all absentees; but this practice, unless carried on with the greatest tact, often results in a feeling of distrust toward the medical department.

Thus the question of assistants is an important one, for when properly chosen they enable a physician to extend his efforts much further than he would otherwise be able to do.

Special Practitioners.—"Obviously industrial physicians are no more able than other physicians to practice competently all of the specialties of medicine, so they are coming more and more to supplement their own work with that of the special practitioners. Ordinarily they refer their patients who require unusual treatments to the specialists, but in some establishments where the demands warrant it specialists have been attached to the dispensary staffs.

"The medical organization of one concern, for example, has a nose, ear, and throat man, an oculist, and a dentist; also a chiropodist; all are employed on a part-time basis. A large automobile company has a surgeon, an oculist, a roentgenologist, and a bacteriologist; also a pharmacist and a masseur. One firm manufacturing cash registers uses hydrotherapy, heliotherapy, and massage to a considerable extent, and has an attendant skilled in these practices. The medical department of a large shipbuilding company, where foreign bodies on the eye are common, engages an oculist for two hours each afternoon. The dispensary staff of a large steel company in Philadelphia includes an oculist who puts in three afternoons weekly, while one of the regular staff physicians is skilled in roentgenology.

"Dentistry . . . is relatively new to the industries, although popular and bidding energetically for general recognition. Thirteen of the 155 medical departments previously analyzed for personnel have dental service. . . .

"The volume of work which three dentists accomplished in 1917 for a large rubber company employing about 15,000 employees is astonishing. They examined the teeth of 20,562 applicants for employment and attended 6073 patients. . . . The opinion was expressed by the chief of a large industrial dental clinic that one dental unit operated from 9 a. m. to 4.30 p. m. daily is necessary for each 500 to 600 employees. In this clinic from 45 minutes to one hour is necessary for each patient, rendering prophylactic or emergency service only, and the cost per unit is $3 per hour."

INDUSTRIAL DISPENSARIES

A very full discussion of the better methods of planning and equipping dispensaries is given, with tables, photographs, diagrams, and lists of instruments and their prices, etc. A dressing room is indispensable. Waiting rooms are advisable in larger establishments, and they should be separate from the apartment in which applicants for work are received, as the sight of injured workmen has a very bad effect upon the newcomer. A small office is often provided for the doctor. Several examination rooms are advisable if applicants for employment are to be given physical examination; they need not be larger than 8 x 10 feet, which is large enough to permit distance tests of vision with the help of a mirror. The number of rooms required will, of course, depend upon the number of examinations to be made daily. An examination usually takes about ten minutes. Wards for bedridden patients are sometimes provided, although it is difficult to calculate in advance how many beds will be required. Rest rooms are best established near the medical department. Operating rooms are often found, but apparently not very often used. A laboratory is too frequently omitted.

Dental offices, X-ray rooms, dark rooms, sterilizing rooms, store rooms, attendants' rooms, and so on, may be provided to fill special needs. In the arrangement of rooms two rules stand out: the rooms which are most frequently used should be the most accessible, and arrangements should be such as to permit passage in and out without confusion.

Equipment.—The various articles of furniture and instruments are described in some detail. They need not be extensive, and the simpler forms of chairs, stands, etc., are often the most useful. An arrangement of furniture which seems to be peculiarly adapted to industrial dispensaries is the dressing unit, which consists of a stand, chairs or stools, and facilities for washing the hands. Attention to the arrangement of furniture will save many steps. Stretchers or ambulances should be provided.

ACTIVITIES OF MEDICAL DEPARTMENTS

The treatment of injuries is, of course, the first and in many plants the only purpose of the medical department. Doctors are frequently judged by the average of the disability periods of the employees. The physician should be familiar enough with the processes in which the men are engaged to be able to decide whether a man should be permitted to continue with his job, and if not, what treatment is best adapted to returning him to work as early as possible. Workmen are often

unwilling to accept lighter jobs during the period of convalescence from an injury when they are unable to do their regular work, because such jobs are usually less well paid; and it is the policy of some companies to allow injured men full pay even on light work, in order to keep them from acquiring the habit of loafing.

Not all industrial dispensaries treat major injuries. Bedridden patients are sent to neighboring hospitals in many cases for treatment, and sometimes for diagnosis.

Trivial illnesses—colds, constipation, and so on—are treated by a majority of the full-time physicians, but part-time and detached physicians often refuse to be bothered with them, or hesitate in the fear that the giving of treatments may imply liability for further care in the event of serious developments. Somewhat over 4 per cent. of the whole-time departments treat serious as well as trivial illnesses.

Laboratory medicine seems to be pretty well neglected in most plants, because of lack of time, funds, training or initiative. It might be worth while in many dispensaries to train a nurse to perform the commoner laboratory tests, as is being done at one plant.

The physical examination of applicants for work is of all degrees of completeness. In some establishments it is restricted to the men handling food; in others, to process workers; in others again to those proposing to enter the mutual benefit societies.

"Somewhat more than one-half of the establishments visited require examinations of those who seek employment—one-half had not yet seen the value of the examinations—and the moment a labor shortage appeared a few of them dropped the requirement. They also had failed to perceive the real value of the examination. This is regression, and at a time when employees and industry must put forth unusual efforts and labor under unusual conditions, a time when both need the support of all measures that are capable of protecting health and securing efficiency. As the theory of physical examinations is fundamentally right, the only logical conclusion is that the theory had not been well applied in those places where regression has occurred. The lesson which industrial physicians must learn is that of the value of thoroughness, and under no circumstances should it be sacrificed to speed or any other circumstances. There are, of course, many industrial physicians who do their work thoroughly in this respect, and who live up to the ideals of industrial medicine. . . . There is much talk about fitting workmen to their jobs, speaking from the standpoint of physical qualifications, but very little evidence of its being scientifically done. In order to do this properly and effectively, the doctors should study the physical requirements of all the various factory operations, a task to which they do not readily adapt themselves. It would appear, therefore, that if a comprehensive study were made of job requirements in the various industries, relating particularly to physical and temperamental qualifications, and the results of such a study were made available to industrial physicians, they would be in a much better position than they are now to apply the knowledge obtained by physical examinations to the proper placement of industrial workers."

Instruction in hygiene is one of the duties taken on by the medical staff of some plants. The most frequent method is by health bulletins, such as those issued by the National Safety Council. In addition, health talks are given in several establishments. Instruction in first aid is often given to men who are compelled to be out of reach of the regular medical service. The first-aid jar devised by the National Conference Board of Industrial Physicians is recommended.

Certain companies have established vacation colonies and sanatoria for their employees.

The medical staff in some instances finds it of advantage to hold periodical meetings to discuss questions brought up in the course of the work. Industrial physicians will always find it worth while to keep in close touch with the local public health authorities.

Records and reports.—There is an unfortunate lack of uniformity among different dispensaries in the matter of records. The author has selected the forms which he considers the best, and gives them in full. Blanks are given for orders for medical attention, for the passage of patients and notes of their appointments, for records of first aid and subsequent treatment, for physical examination—cursory or complete—for special diseases, as tuberculosis and occupational disease, and for dental examination and treatment.

THE VALUE OF INDUSTRIAL MEDICAL SERVICE

"The reasons which induce employers to provide their workers with medical service may be summarized as follows:

"1. It is an acknowledgment of their obligation toward the workers who sustain injuries during employment and an economical means of procuring expert attention for them.

"2. It is deemed capable of removing or minimizing certain causes of lost time.

"3. It is one of several activities that have been found to be of use in removing certain unstabilizing influences from employment, and as such can be expected to assist in holding down the labor turnover.

"4. It enables the workers to produce more.

"5. It prevents litigation and reduces compensation expense.

"6. It contributes to a sense of security among employees and promotes a feeling of goodwill toward the management.

"7. Conditions make it imperative in isolated industrial establishments."

On starting medical service.—Industrial medical service should never be begun on the basis of charity. The workers must be made to feel that it is a part of their rights, and that it should be of advantage both to themselves and to their employers. Perhaps the best way to begin is with a part-time surgical dispensary, which the workers are always willing to accept, and which may be enlarged to embrace as many of the activities open to the industrial physician as may be desired. Often, if one plant is not large enough to support an adequate medical department, it will be found of advantage for several

firms to combine in the establishment of a hospital convenient to all.

SUMMARY AND CONCLUSIONS

"1. Industrial medicine is the theory and practice of medicine applied to the prevention of sickness among industrial workers, and their prompt restoration when sickness or accidental impairment have occurred.

"2. To be effective, industrial medicine must not be limited to the care of injuries. . . .

"3. The relation of industrial physicians to plant organization should be such as to favor correlation and make for greatest efficiency. It is better that they look to the directing heads for authority, rather than to departmental heads.

"4. Whole-time medical service seems to be feasible in small establishments, and wholly desirable in large establishments. . . .

"5. The personnel which may be required to render effective service depends more upon the ability of the directing physician to create demands for the services of his department in health maintenance than upon the number of injuries which are sustained by the workers.

"6. . . . Physicians who intend going into industrial service should seek special training in that direction which will enable them to adapt their knowledge to the requirements of industrial work.

"7. A part-time physician is never wholly an industrial physician. . . .

"8. Doctors who render industrial service only upon request are better paid proportionately than those who render part-time service, and these are better paid proportionately than those who render whole-time service.

"9. Trained female nurses are in greater demand as assistants in industrial dispensaries than any other class of attendants.

"10. The evolution of industrial medicine and its growing importance is attracting specialists to the industrial field. Prophylactic dental service, an example of this specialization, is becoming deservedly popular.

"11. Industrial dispensaries should be accessible . . . The arrangement of equipment . . . should be such as to permit rapid care of patients in an orderly manner.

"12. Whole-time physicians render more varieties of service than part-time physicians. . . .

"13. While keeping records and making reports are essential to the operation of industrial medical departments, there appears to be a great variety of methods and forms used. . . .

"14. Industrial medicine is not only humane, but is essential to production. It is beneficial to workers and profitable to employers. It offers splendid advantages to physicians for the development of careers in a field of rapidly growing importance, vital with opportunities for service to humanity."

A bibliography of reprints and bulletins issued by the Public Health Service dealing with related subjects is given. These, like the present report, may be obtained free or at a nominal price from the Public Health Service, Washington, D. C.—T. J. Putnam.

INDUSTRIAL NURSING

Public Health Nursing. Editorial, California State Board of Health, Month. Bull., May, 1919, 14, No. 11, 373.—The U. S. Public Health Service urges the training of more public health nurses to extend the campaign of venereal disease control. Further recommendations for training women for public health nursing are included.—L. A. Shaw.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Lessons From Housing Developments of the United States Housing Corporation. *Frederick L. Olmstead.* U. S. Bur. Labor Statis., Month. Labor Rev., May, 1919, 8, No. 5, 27-38.—This article reviews briefly the conditions of hasty mobilization of labor into communities offering only limited housing facilities, with the result that through the United States Housing Corporation the government was forced to take an active part in providing houses in order to improve and stabilize labor. The housing shortage has been aggravated generally in the past few years by tendency to make investments in other lines. Aside from the emergency conditions brought about by the war, the decline of interest in housing has had a social significance in that it leads to crowding and a decrease in the permanency of residence. The writer points to the success of the Housing Corporation in producing pleasing effects in the building of groups of houses by slight variations in construction, by the proper placing of houses, and by a scientific development of new streets.—C. H. Paull.

The War Housing Program and Its Future. *N. Hitchcock.* Jour. Pol. Econ., April, 1919, 27, No. 4, 241-280.—The greater part of this article is a history of the housing projects carried out by the U. S. government, and a description of the administrative organization developed for this purpose. The remainder discusses the broader aspects of this experiment, and the future of industrial housing.

"The net conclusion . . . is that as a national experiment the government war housing program cannot yet be said to have demonstrated anything. It has not had time. But the nation, if it wishes, still has the opportunity to ascertain

its real value. There are two possible courses open to the government: it can adopt the *laissez faire* method of disposing of its property at the first opportunity to the highest private bidder, seeking only the largest possible amount of immediate salvage; or it can hold it until a far-sighted policy can be worked out. . . ."

The author feels the "necessity for a survey of the whole situation by a competent agency with a view to planning and recommending a comprehensive national scheme for handling the whole problem. . . . The logical suggestion seems the establishment of a federal housing commission, composed of experts, some of whom at least have assisted in the war construction program."—Linda James.

THE WORK OF THE RECONSTRUCTION LEGISLATURES. *F. Rex* and *Richard S. Childs.* Nat. Munic. Rev., July, 1919, 8, No. 5, 366-378.—Action taken by many legislatures and cities, in regard to improvement of housing facilities for the working man, is reviewed on page 367. Illinois, Texas, North Dakota, Boston and New York are mentioned particularly.—Linda James.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

CONVENTION OF EMPLOYMENT MANAGERS. Ind. Management, June, 1919, 57, No. 6, 489-491.—An account of the convention of the National Association of Employment Managers held in Cleveland, May 21 and 22. This report contains papers on *Training and Placing the Disabled* by W. A. Sawyer, *Safety as the Employment Executive Should See It* by Sidney J. Williams, *Human Relations Department from the Standpoint of the Industrial Physician* by Dr. Otto P. Geier, *Human Relations and the Industrial Physician* by Robert S. Quimby.—C. H. Paull.

A CLASSIFICATION OF EMPLOYMENT MANAGEMENT FUNCTIONS. *Roy W. Kelly.* Ind. Management, June, 1919, 57, No. 6, 476-477.—The author tabulates the duties of the employment manager under the headings of Recruiting, Developing the Sources and Channels of Labor Supply, Adjustments, Training, General Education, Group Relations, Co-operative and Service Activities, Health and Safety, Records and Research.—T. J. Putnam.

PRINCIPLES OF EMPLOYING LABOR. *E. H. Fish.* Ind. Management, June, 1919, 57, No. 6, 478-482. —In this discussion, the last of a valuable series of five, which started in the February number, Mr. Fish suggests a number of "non-financial reasons for quitting" which are related to safety and health in industry. He points out the danger of confusing safety appliances and safety practices. Employers ought never to allow themselves to be satisfied to substitute a monetary return through insurance to take the place of the most adequate safety precautions possible. Unsanitary and disagreeable working conditions not only tend to increase labor turnover, but also to lower the standard type of labor available. The prospect of employment during the entire working life rather than to an arbitrarily established age limit has much to do with the worker's happiness and health in his work and his consequent efficiency and permanency of employment.—C. H. Paull.

TRAINING AND PLACING THE DISABLED. *W. A. Sawyer.* Ind. Management, June, 1919, 57, No. 6, 494-495.—Every year for the past fifty years we have had a far greater number of disabled men from industry than the total list of our casualties from the war. We need more measures for prevention and for rehabilitation. The disabled worker should be re-employed, not as a charity, but on a footing with other workers. This is made possible in almost every instance by careful job-analysis.—T. J. Putnam.

TESTS OF INTELLIGENCE: RELIABILITY, SIGNIFICANCE, SUSCEPTIBILITY TO SPECIAL TRAINING AND ADAPTATION TO THE GENERAL NATURE OF THE TASK. *E. L. Thorndike.* School and Society, Feb. 15, 1919, 9, No. 216, 189-195.

THE VALUE OF THE INTELLIGENCE QUOTIENT FOR INDIVIDUAL DIAGNOSIS. *J. E. W. Wallin.* The Journal of Delinquency, May, 1919, 4, No. 3,109-124.

THE DIAGNOSTIC FALLIBILITY OF INTELLIGENCE RATIOS. *F. Mateer.* Pedagogical Seminary, Dec., 1918, 24, No. 4, 369-392.—This and the above two papers may well be read in conjunction with one another. The first paper contains especially a consideration of the dangers of error and misapplication in making intelligence tests in colleges, business institutions and the like where coaching may be possible, and several practical methods of overcoming the possibility of coaching are mentioned. The other articles are reports of critical studies of the value of intelligence ratios, and are in agreement in attempting to show the limitations of the mathematical formula and the need of taking into consideration clinical and other aspects of individual cases. The results of these studies cannot be presented in brief summary, since the methods employed and the values in question can be understood only by being precisely defined and considered in detail.—G. E. Partridge.

INTELLIGENCE AND EFFICIENCY TESTS DISTINGUISHED. *A. L. Ide.* The Psychological Clinic, May 15, 1919, 12, Nos. 5-9, 204-209.—There are two classes of tests: those of capacity, and those of accomplishment. The intelligence test attempts to measure mental unitary powers, the efficiency test tries to measure the results of combined powers.—G. E. Partridge.

WAR PSYCHOLOGY AND EDUCATION. *E. K. Strong.* School and Society, June 14, 1919, 9, No. 233, 697-705.—The war has brought out the

necessity of dealing with the whole problem of personnel more effectively. Men must be trained for the positions in which they can accomplish most for society and attain the greatest happiness. Classification can be accomplished by the use of intelligence tests, trade tests, rating scales and expert interviewing. Definite specifications of the various lines of work are as necessary as definite analysis of the worker, for the proper assigning of one to the other. Vocational guidance can thus be carried out scientifically, and it should be introduced and perfected throughout our whole educational system in connection with a system of efficient public employment offices in our industrial concerns. The problem of morale should be studied, since making a man happy in his work is quite as important as teaching the work itself.—G. E. Partridge.

THE WORK OF THE TELEPHONE OPERATOR. *J. Fontègne* and *E. Solari.* Archives de psychologie, 1918, 17, No. 66, 81-130.—This is an excellent and typical study of vocational psychology. The author believes that occupational orientation is one of the most pressing of our educational and economic problems, and that the methods of psychology in a broad sense must be applied to the work of analyzing the individual and work. The present study was undertaken to determine the factors of efficiency in the work of telephone operators, and upon this basis to devise a practical test of such efficiency that might be applied to applicants. Primary memory, ordered memory, ability to estimate spatial relations, quickness of movement, precision of movement were studied, and the results compared with estimates of efficiency based upon work. Good auditory memory for numbers, power of sustained attention, quickness of movement, quick reaction to visual stimuli were found to be the essential qualifications that must be measured.—G. E. Partridge.

WORKMEN'S COMPENSATION AND INSURANCE

MEDICAL BENEFITS AND THE MEDICAL PROFESSION UNDER WORKMEN'S COMPENSATION LAWS. *Carl Hookstadt.* U. S. Bur. Labor Statis., Month. Labor Rev., May, 1919, 8, No. 5, 39-61.—In this article the writer reviews the forty-two workmen's compensation laws effective in the United States on January 1, 1919, from the standpoint of medical service provided and the administration of this service. The amount of medical aid ranges in cost from $25 to $250. In some states there is no time provision for medical treatment, while in others the time is unlimited. In less than one-half of the states the employer is required to provide medical service for more than 30 days. The inadequacy of most of these provisions from the standpoint of the worker is shown in tables which give the periods of disability for several states. Compensation laws vary in placing the responsibility for the selection of the physician. The writer points out that the selection of the physician by the employer tends to protect ignorant workers against unscrupulous doctors. On the other hand, workers feel that they have the right to make the selection of a doctor. In some cases, the industry has failed to make a wise selection, and at times there is danger that physicians working for a reduced fee for an industry will do superficial work. The writer discusses the various plans followed in different states for establishing rates for physicians and hospitals in the treatment of industrial cases. In conclusion he calls attention to the scheme adopted in the state of Washington for administering medical service through local boards.—C. H. Paull.

SELECTION OF THE PHYSICIAN UNDER COMPENSATION LAWS. *J. W. Mowell.* U. S. Bur. Labor Statis., Month. Labor Rev., May, 1919, 8, No. 5, 248-250.—This is a paper which the writer presented at the Fifth Annual Meeting of the International Association of Industrial Accident Boards and Commissions. He discusses three phases of the subject from the standpoint of the compensation law of the state of Washington:

1. The choice of a physician by the injured worker.
2. The selection of a physician by the employer, after securing consent of the worker.
3. The selection of the physician for special work by the industrial insurance commission.—C. H. Paull.

REHABILITATION OF DISABLED EMPLOYEES

HELPING THE WOUNDED SOLDIER TO "COME BACK." *B. T. Baldwin.* Mod. Hosp., May, 1919, 12, No. 5, 370-374.—A detailed statement of the development of occupational therapy in the Walter Reed General Hospital.—C. K. Drinker.

REHABILITATION THROUGH SYSTEMATIC EXERCISE. *A. F. Gugel.* Mod. Hosp., May, 1919, 12, No. 5, 322-324.—A very general article on the above subject. No details are given as to the character of the systematic exercise.—C. K. Drinker.

REHABILITATION OF THE DISABLED. *Frank Billings.* Jour. Am. Med. Assn., May 24, 1919, 72, No. 21, 1505-1513.—This article first summarizes governmental work for those disabled in the war. In Part II there is a discussion of the rehabilitation of the industrially disabled.

Seven hundred and fifty thousand people in eighteen of the states in this country are injured annually in industrial occupations; 35,000 of these are permanently disabled. It has also been stated that 80,000 people are permanently disabled annually in the whole United States through acci-

dents received in industrial occupations. Of these it is stated that 2000 are totally disabled. At the present time, little effectual work is being done towards the rehabilitation of this enormous group of workers.

The cost of rehabilitation should be borne in proper ratio by the federal, state, county and municipal governments and the corporations employing labor. All institutions now giving treatment and care to injured men should be properly equipped for efficient physiotherapy. After passing through the earlier stages of recovery the patient should be placed in a well-organized vocational training school and prepared for his old or for a new job. When rehabilitation is impossible just pensions should be given.—Katherine R. Drinker.

Re-educating the Disabled Man. *John C. Faries.* Am. Jour. Care Cripples, Jan., 1919, 8, No. 1, 3-10.—The Red Cross Institute in New York has established a "curative workshop" in connection with the hospital to teach a disabled man during convalescence some trade, preferably one allied to his former work, in order to return him more quickly to the community as a self-supporting individual. Handicapped men are not coddled, but are stimulated by encouragement and instruction to self-help. Disabled plasterers, for example, are trained to be foremen and estimators; disabled men without trades are taught to become oxy-acetylene welders, motion-picture operators, mechanical draughtsmen; in many cases with increased earning capacity.

To support disabled men and their families during the period of training, the Institute makes small weekly loans to the men, or procures for them part-time employment, a partial but not completely satisfactory solution of the problem. —Rhea Fuller.

The Bankhead-Smith Bill: A Measure to Promote the Vocational Rehabilitation of Disabled Civilians. Am. Jour. Care Cripples, Jan., 1919, 8, No. 1, 63-64.—A bill for promoting the vocational rehabilitation of the disabled.—Rhea Fuller.

Testimony on the Bankhead-Smith Bill. *Douglas C. McMurtrie.* Am. Jour. Care Cripples, Jan., 1919, 8, No. 1, 65-69.—Mr. McMurtrie considers that best results are obtained in special schools for the disabled, with a special staff of workers trained for the requirements of the work. In the Red Cross Institute a variety of courses are offered free, and yet it has but forty of the thousands of crippled men in New York City. The solution seems to rest with the state compensation authorities. Rehabilitation and compensation should go hand in hand, instead of the former discouraging the latter. Until pensions are paid for personal injury only, it will be difficult to persuade the crippled to take up re-education.

To extend the work, bureaus for the handicapped should be established in every large city. Many men need only vocational guidance and intelligent search for a suitable job.—Rhea Fuller.

Victory Over Blindness. *Arthur Pearson.* Am. Jour. Care Cripples, April, 1919, 8, No. 4, 299-309.—A description of St. Dunstan's in London, with 16 acres of land attached, resembling an industrial village and organized for the special activities of the blind. The patient is imbued with the spirit of fight rather than that of resignation. He must not consider himself afflicted, but only faced by the necessity of readjusting his faculties to the altered conditions of his life. He is taught reading, typewriting, shorthand, massage, carpentry, weaving, basket-making, the care of poultry, etc., with the result that the great majority of the men who leave St. Dunstan's make more money than they did when they could see. With the object of keeping men in a normal state of mind, play is considered quite as important as work. Dancing, cards, checkers, rowing, swimming, etc., are heartily enjoyed. Teachers who are themselves blind are considered a great asset because it gives the pupils confidence in themselves. When a man leaves St. Dunstan's, he passes into the charge of the after-care department, which has regular visitors to visit the man in his home in case he is not in outside employment. Whenever possible, however, the man is returned to his original occupation.—L. A. Shaw.

St Dunstan's and the Blinded Soldier. *Frederick Martin.* Am. Jour. Care Cripples, April, 1919, 8, No. 4, 314-321.—The subject matter of this article is covered in "Victory Over Blindness," abstracted above.—L. A. Shaw.

ABSTRACT *of the* LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME I — OCTOBER, 1919 — NUMBER 6

CONTENTS

GENERAL

GREAT BRITAIN, ANN. REP. CHIEF INSPECT. FACTORIES AND WORKSHOPS FOR 1916. Parliamentary Paper, Cd. 8570, 1917, 1-4.—During the past year there was a large extension of munition works, and important developments took place in the manufacture of explosives, chemicals, glass, hosiery, needles and other articles previously imported. This report, like the last, deals largely with the special duties enforced by the war. The medical inspectors were actively engaged in the investigation and prevention of "dope-poisoning" incident to the varnishing of aeroplane wings; a new "dope" has been introduced which is free from the poisonous tetrachlorethane. Study was also made of the poisonous materials entering the manufacture of explosives, especially T.N.T. Very satisfactory results have been obtained in reducing the number of fatal cases of T.N.T. poisoning. Cases of anthrax have increased, owing to the necessarily indiscriminate use of wool of inferior quality.

The Miscellaneous Provisions Act of 1916 contains two clauses affecting the work of the Factory Department. One makes it no longer necessary for the occupier of a factory to report accidents to the surgeon. The latter is only called upon to investigate those cases referred to him by the district (factory) inspector in pursuance of instructions issued by the Secretary of State under the act. The other clause empowers the Secretary of State to require by order in any factory or in any class of factories certain "welfare" provisions for the well-being of the workers. The need for welfare provisions is now legally recognized. This whole question became more prominent because of the great increase in

the number of women employed in factories during the war. In many of the large munition works excellent provision has been made for the health, comfort and social welfare of the employees. Most of the inspectors comment upon the improvements in working conditions in factories, especially where women have been introduced; and in many cases employers have provided tea in the afternoons free of charge for those working overtime, with very beneficial results.

The most important work done during the year was in connection with the substitution of women in manufacturing industries. Trade conferences were held to consider reorganization of conditions of work so as to release men for the army. Long-standing customs in the trade and the necessity of providing suitable sanitary accommodations for women in the works in which they had not before been employed have caused difficulties, but progress has been made.

In the supervision over hours of labor, it has been found that the general tendency has been to restrict weekly hours of work to an amount very little in excess of those allowed by law, and to arrange for more elasticity in the daily limits. It has become recognized that continuous and excessive overtime very soon affects injuriously efficiency as well as the quantity and quality of work. In one weaving factory special records were kept when the normal hours of fifty-five and one-half hours a week were increased for sixteen weeks to fifty-eight, and for four weeks to sixty-five and one-half. The output did not increase in proportion and the difference was more marked when working the sixty-five and one-half-hour weeks. On the other hand, a moderate amount of overtime judiciously arranged gave satisfactory results.—B. Cohen.

Industrial Health and Efficiency. Final Report of the British Health of Munition Workers Committee. U. S. Dept. Labor, Bur. Labor Statistics, Bull. No. 249.—This most exhaustive report is a summary of all of the work of the British Health of Munition Workers Committee, and is published with the hope that it will prove of great value to the employers and workers in this country, although it represents British shop and labor experiences.

All phases of working conditions and welfare provisions have been investigated and are discussed with the result that this volume probably represents more complete, concrete and valuable experience than has previously been collected. Of special importance are those sections of the report dealing with Hours of Labor, Injuries and Accidents, Rest Periods and Working Shifts. A discussion of some 250 pages is followed by a series of conclusions and an appendix.

This report should serve as an excellent guide to plant officials and is to be highly recommended for its assistance in solving some hitherto unanswered questions regarding many of the facets of industrial life.—L. Greenburg.

The Correlation of Neurology, Psychiatry and General Medicine as Scientific Aids to Industrial Efficiency. *Jau D. Ball.* Am. Jour. Insanity, April, 1919, 75, No. 4, 521-555.—This is a short, rather disjointed article dealing with a big subject, but dealing with it in a helpful manner that should point the way to further work along these lines. The idea is that industry can be stabilized and an enormous reduction of labor turnover accomplished by getting at the individual workman and satisfying him individually.

"Information and groundwork for this research was gained by visits to large industrial plants, including one of the large ship-building plants on the Pacific Coast. Personal interviews were had with managers, superintendents, foremen, and men, and opportunity offered for study of individuals. Careful study was made of the methods of employing labor, not only the methods used at the individual plants, but also methods observed at United States employment offices. What particularly impressed the author was the fact that the efficiency of every plant was practically dependent upon the methods used in its employment bureau. It is the keystone to the entire arch of industry. True, at the present time this keystone is a little unstable, but by the proper co-operation of capital and labor and the realization by both of the great necessity for the proper selection and distribution of labor, it will be possible to imbed it more firmly in the cement of good fellowship and loyalty.

"The loss to many industries through the termination of individuals unsuited for a particular job, but having unascertained special abilities, is enormous. The salvage of this human material should be undertaken by a scientifically equipped employment bureau."

The first step in this program is to treat each employee as a case, and to keep a chart indicating his physical and mental equipment, with suggestions as to how he should be handled and what work he is best suited for. With these facts in hand, the employer can give each man full opportunity and receive from him maximum efficiency, thus establishing mutual confidence and co-operation.

A laboratory report is made, consisting of a general medical examination, neurological examination, psychiatrical examination, and psychological examination. Good outlines are given for each of these, and the questionnaire used in the psychiatrical test is given in full. The psychological test is one that can be applied to a group of twenty-five or more. It is adapted from that used in the Navy, and has the advantage of brevity and proved value. It is fully explained in the paper.

In his conclusion, the author pleads for the establishment of medico-psychological laboratories in all large industrial organizations, to carry out this method of putting the right man into the right job. He enumerates at length the benefits that would arise from such a scientific selection and distribution of labor. We might be sceptical about his claims if we did not keep clearly in mind the fact that he must be fundamentally correct, for he bases his work on giving individual attention to the personal problems of each employee.—S. Cobb.

Securing the Initiative of the Workman. U. S. Bur. Labor Statis., Month. Labor Rev., June. 1919, 8, No 6, 134-136.—Robert B. Wolf believes that modern industry affords no chance for the constructive impulses in man, with the result that these impulses are turned into destructive channels. The employee must have a voice in determining working conditions. Where there are brains, they must be worked intelligently or ey will be turned to evil purpose. If we wish to enlist the initiative and the intelligent interest of our workers, they must be shown the relation of their work to the finished product.—L. A. Shaw.

Plans for the Hygiene of the Future. *Paul Schmidt.* Deut. med. Wchnschr., April 24, 1919, 45, No. 17, 57-59.—A plea for the establishment of a general bureau of health, to preside over the usual public health activities, and in addition, over the hygiene of industry and of dwellings, the welfare of women and infants, and the measures directed against the communicable diseases, especially tuberculosis and the venereal diseases. We must not forget, as the author reminds his countrymen, "that newly-won, broader personal liberty does not give anyone the right to endanger his fellow men and society through lack of thought and carelessness in matters of health." —T. J. Putnam.

The Relation of the Railroads to the Public Heatlh. U. S. Pub. Health Ser., Pub. Health Rep., 34, No. 27, 1469-1473.—The Railroad Administration, in developing its organization, appointed a committee on health and medical relief to make a survey of the surgical and medical field, in so far as it related to the railroads. The committee found the railroads to be partly responsible for the continuance of malaria, because of the embankments which subvert the natural drainage. Inasmuch as the railroads draw a large number of employees from communities in the South where hookworm is prevalent, this disease is of vital interest to them.

The United States Railroad Administration desires to assist in carrying out all the health regulations of the United States Public Health Service and of the various states.

Water-closets and washing facilities in railroad stations and on passenger cars are unsanitary and filthy. In the case of stations, it is unjust that individuals of a community should demand better facilities than they themselves are willing to provide. The committee, however, is now drafting a set of standard sanitary rules for adoption by the railroads.

Health posters about railroad property are to be permitted only on condition that they conform to the standard established by the committee.

It is recommended that steps be taken to ascertain whether the irreducible minimum of accidents has been reached. The annual toll of 194,000 injuries seems heavy, and measures of rehabilitation, similar to those adopted by the government in salvaging disabled army men, should be carefully considered.—L. A. Shaw.

Functions and Plan of Organization of Division of Industrial Hygiene. *C. D. Selby.* Am. Jour. Pub. Health, July, 1919, 9, No. 7, 521-525.—In this paper Dr. Selby outlines the plans of the U. S. Public Health Service in co-operation with the Working Conditions Service of the Department of Labor for creating and developing a governmental agency for the protection of the health of industrial workers He points out the need of determining standards for working conditions, and emphasizes the desire to effect a friendly leadership in all matters of industrial hygiene and medicine.

In approaching this objective the division proposes: (a) to initiate and encourage researches in industrial hygiene and medicine; (b) to determine standards and aid in their promulgation; (c) to develop preventive medicine and surgery (including the medical and surgical phases of the rehabilitation of impaired workers) in the industries and the industrial zones; (d) to develop facilities for the training of physicians, s n.tarians and nurses for industrial service; (e) to develop a system of industrial vital statistics; and (f) to inaugurate an active informational campaign—all to the end that the health and lives of the industrial workers may be safeguarded against the hazards of industrial service. —H. F. Smyth.

Practical Instruction in Hygiene in Medical Schools. *Allyre Chassevant.* Rev. d'hyg., April, 1919, 41, No. 4, 369-376.—For two years, a course has been given at the Faculté de Medecine de Paris, covering the following subjects:

1. *Industrial Hygiene:* Study of confined airs, psychrometry, proportion of carbon dioxide, tests for carbon monoxide, and for the various toxic industrial gases. Sampling of dusts and smokes. Microscopic examination of mineral, vegetable and animal dusts. Accurate sampling of air for complete chemical analysis. Sampling of dust for bacteriological examination.

2. *Hygiene of Dwellings:* Cursory examination of the common materials of construction, measure of their porosity. Examination of an architectural plan, and criticism. Air-space of a room; lighting, heating and ventilation.

3. *Personal Hygiene:* Examination of the principal textiles; measurement of their permeability to air; methods of waterproofing.

4. *Sterilization and Disinfection:* Use and action of autoclaves, incinerators, disinfecting stoves. Control of disinfection: fusion tests, bacteriological tests. Cursory analysis of the commoner chemical disinfectants.

5. *Nutritional Hygiene:* Brief notes on the fuel value of the chief foods; their composition; methods of extracting and estimating fats, carbohydrates and proteins.

Milk analysis, sampling. Content of solids and of fat. Purity. Lactodensimetry. Control of pasteurization.

Vegetable foods: microscopic examination of flours; gluten content; analysis of bread; search for rot, blight and ergot.

Animal foods: examination of meats for parasites, and for evidences of decomposition.

Controls of the sterility of canned goods.

6. *Drinking Water:* Accurate sampling of

water for chemical analysis. Source and temperature. Hydrotimetry. Tests for suspicious impurities. Interpretation of results. Fluoroscopy, electrical resistance.

7. *Waste Waters:* Sampling of sewage and of mud. Tests of putrefaction.

Lack of funds has prevented further extension of the course, but it is hoped gradually to increase its scope. The author believes that sanitarians should specialize more in the various fields of hygiene, and not try to cover too much ground.—T. J. Putnam.

Education in Industrial Medicine. *Otto P. Geier.* Modern Medicine, June, 1919, 1, No. 2, 133-136.—A plan for the establishment of a Department of Industrial Medicine and Public Health in the College of Medicine of the University of Cincinnati, to provide facilities and instruction for graduate and undergraduate medical students in industrial medicine and public health, which will be taught in co-operation with the industries and public health agencies, leading to degrees in industrial medicine and public health; and to provide for co-operation with the National Safety Council and Employment Managers' Association in arranging courses of study. As a tentative plan, the course of instruction will occupy one college year of approximately eight months, beginning October, 1919, and will be open to graduates in medicine. Part of the instruction will be given at the college, and part in the various industries. Subsequently, the students will be assigned to work in co-operation with the plant physicians, dentists, safety engineers and employment managers. Finally, each student who qualifies for the work will be assigned to some plant to serve an interneship, and from this time on it is expected that he will be remunerated for his services. A special course of lectures will be given under the supervision of the Safety Council.—T. J. Putnam.

References from Monthly Record of Current Educational Publications, February, March and May, 1919.—These bulletins contain sections dealing with the current literature of education that are of interest to the student of industrial hygiene. There are sections on educational tests and measurements, school hygiene, physical training, child welfare, manual and vocational training, vocational guidance, agricultural education, commercial education, military training, re-education of war invalids. Brief abstracts of some of the papers are given.—G. E. Partridge.

Educational Notes and News. School and Society, July 26, 1919, 10, No. 239, 101-106.—An Association for the Advancement of Education in Industry and Commerce has been founded in England under the presidency of Lord Leverhulme. The membership includes many of the great industrial and commercial firms of the country. The purpose is to co-operate with other educational forces and to participate in the general advancement of education. Some of the firms have founded schools in connection with their own establishments. The effort is not to be directed merely toward improvement in vocational education, since it is recognized that the problems of education of the working classes to-day are quite as much problems of leisure as of industry.—G. E. Partridge.

The Establishment of Unit Trade Schools in Cities of Twenty-five Thousand or Over. *F. H. Wing.* National Society for Vocational Education, Bull. No. 30, June, 1919, 18-29.—"The general establishment of the unit trade school is one successful step in the solution of the problem of vocational industrial education, but even the extension to the limits of its legitimate field will leave unsolved the problems of the unskilled and semi-skilled workers. Nevertheless, the approach to the problems of industrial education through the preservation and development of suitable occupations, where these occupations obviously function, may point the way to a similar successful method of grappling with the problems of the specialized industrial worker."—G. E. Partridge.

The General Industrial School for Cities of Less Than Twenty-five Thousand Population. *W. P. Loomis.* National Society for Vocational Education, Bull. No. 30, June, 1919, 35-42.—"It has been demonstrated that through the medium of the general industrial school the occupational education of the boy may be followed from the time he is able to choose his occupation until he has become the finished product. He may be guided through all the stages of his development."—G. E. Partridge.

The Part-Time, Evening, and All-Day Vocational School. *J. P. Munroe.* Vocational Summary, March, 1919, 1, 10-12.—G. E. Partridge.

Some Fundamentals for Vocation Teachers. *K. G Smith.* Vocational Summary, February, 1919, 1, 17-19.—G. E. Partridge.

Labor's Attitude Toward Education. *H. Sterling.* School and Society, Aug. 2, 1919, 10, No. 240, 128-132.—An article emphasizing the need of urging upon Congress the inauguration of a more intelligent, liberal and constructive policy in regard to education. The paper contains excerpts from the official reports of the American Federation of Labor from 1911 to 1919, showing the interest of labor in education and in the creation of a federal department of education.—G. E. Partridge.

America's New Physical Education Service. *Martha Candler.* The Child, July, 1919, 9, No. 10, 433-435.—At least 50 per cent. of the 25,000,000 school children of America have been shown to have defects and ailments that in some degree impede mental and physical development. The school is the logical place in which to begin the correction of the physical deterioration that has shown itself at another level in the disqualification for military service of about 30 per cent. of drafted men. Seven states have more or less adequate compulsory physical education laws, but the problem is at heart a national one, requiring federal assistance and co-ordination.

In addition to school supervision there must be attention to housing and adequate food, and there must be sane regulation of juvenile labor. Physical education is, however, the essential method of correction, and the problem of reaching adults throughout the country with a constructive physical education will be simplified when the desire for physical recreation shall have been implanted in the growing child.—G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

CENTRAL NERVOUS SYSTEM

Mental Disease in Families. *Abraham Myerson.* Ment. Hyg., April, 1919, 3, No. 2, 230-239.—There has been much written on the inheritance of insanity, but the methods of collecting data are open to criticism. Too often the author has been trying to fit the data into a theory. Myerson studied the family history of 16,000 patients admitted to a state hospital during a period of sixty-two years; thus the descendants of the insane could be looked up—a more valuable procedure than simply asking for a history of antecedent insanity. He agrees with the students of the subject that: (1) There is far more insanity in the families of the insane than in normal families, especially in a direct line through parents and grandparents; (2) Insane uncles and aunts occur about as frequently in the families of the sane as in those of the insane; (3) Nervous disease (presumably in its strict sense meaning neurological conditions), senile dementia and apoplexy occur as frequently in the families of the sane as in those of the insane.

The marriage rate of patients who later develop alcoholic insanity is low, as is that of those who develop dementia præcox. In other words, "whatever is back of dementia præcox, it operates against self-perpetuation." Mental disease tends to appear at an earlier age in each succeeding generation—another conservative mechanism. The types of insanity inherited are usually similar to the disease of the ancestor: dementia præcox follows paranoid psychoses and dementia præcox; manic-depressive follows manic-depressive, although dementia præcox is often found; dementia præcox usually follows involutional psychoses; feeble-mindedness often follows dementia præcox. In short, like follows like, but "all roads seem to lead to dementia præcox and from thence to imbecility."

In relation to other factors, it was found that insanity tends more to low-grade mentality and feeble-mindedness than it does to genius and talent. Criminality was an inconspicuous feature in the families studied, and it is the author's belief that criminality stands in closer relationship to forms of feeble-mindedness and alcoholism than it does to insanity.—S. Cobb.

Mental Disorder Considered as a Psychological Reaction. *Milton A. Harrington.* Ment. Hyg., April, 1919, 3, No. 2, 220-229.—Abnormal mental reactions are the product of (1) difficult situations, plus (2) personality defects. Psychogenic disorders are simply the reactions of human beings to situations in which they are placed, and as both the situation and the personality are infinitely variable, the types of mental disorders cannot be classified arbitrarily into a few main diseases as is done at present by most psychiatrists.—S. Cobb.

The Psychiatric Thread Running Through All Social Case-work. *Mary C. Jarrett.* Ment. Hyg., April, 1919, 3, No. 2, 210-219.—This is a paper by a social worker of wide experience in the psychiatric field, and her figures showing that from 17.5 per cent. to 50 per cent. of all social service cases have distinct psychiatric problems must be taken as most significant. In practically 100 per cent. of all cases, the point of view that psychiatry can give the social worker in understanding human nature is important in the handling of the many types of personality encountered. The author cites the case of a man shown at a clinic given for employment managers who thought the patient was "just like everybody else." As a matter of fact, he showed temperamental difficulties of a well-recognized psychopathic nature and was helped by treatment. The attitude of mind which allows one to look upon all anti-social behavior as interesting symptoms of mental pathology not only saves the worker from the wasteful emotions of annoyance and indignation, but salvages many cases that might have been impatiently dismissed.—S. Cobb.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Gas Warfare—Its Aftermath. *Joseph Catton.* Mil. Surgeon, July, 1919, 45, No. 1, 65-74.—Although the aftermath of gas warfare is varied, it seems to be an expression of pathological physiology which may be more marked in one or another organ or system. It seems to depend primarily on deficient oxidation in the body. The conditions most likely to present themselves some time after gassing are:

1. Neuro-circulatory asthenia or effort syndrome. "In gas cases this group of symptoms seems to be due to disturbances in the cardiac, respiratory and vasomotor reflexes which, in addition to their other functions, are essential to the oxidative processes."
2. Conditions in the respiratory system, such as laryngitis, aphonia (functional), chronic bronchitis or emphysema.

3. Nervous and mental disturbances.
4. Pigmentation and scars from burns.

The relation of gassing to tuberculosis has not been investigated. It is quite possible that there does exist a relation between it and some gastro-intestinal disturbances and nephritis.—H. A. Bulger.

Present Ideas of Carbon Monoxide Poisoning. *V. Balthazard.* Bull. de l'Acad. de méd., April 8, 1919, 41, No. 14, 439-441.—The author believes that the visceral degenerations reported in carbon monoxide poisoning are artifacts, and that all the other manifestations can best be explained as a result of oxygen starvation. Thus, a concentration of 1:500 of carbon monoxide is not fatal except after a long time, while higher concentrations are rapidly fatal. The canary dies in an atmosphere of 1:350, where a guinea-pig lives for a long time, indicating that the rapidity of the circulation is a factor in susceptibility to poisoning.—T. J. Putnam.

On a Method of Detecting Carbon Monoxide. *A. Desgrez* and *A. Labat.* Bull. de l'Acad. de méd., June 3, 1919, 81, No. 22, 764.—Potain and Drouin showed in 1898 that carbon monoxide produced reduced palladium in a solution of acidified palladium chloride. The authors suggest that a large sheet of unsized paper should be dipped in a 1 per cent. solution of neutral palladium chloride, and dried in a dark place. Strips cut from it are to be partly dipped in water, and suspended in a chamber which is to be filled with the air to be tested through a tube containing lead acetate, to remove any sulphuretted hydrogen. If carbon monoxide is present in amounts from 1:3000 to 1:1000, the moistened part of the paper turns a distinct gray in five to six minutes. The darkening proceeds more rapidly in higher concentrations.—T. J. Putnam.

Vitiation of Garage Air by Automobile Exhaust Gases. *G. A. Burrell* and *A. W. Gauger.* U. S. Bur. Mines, Tech. Paper No. 216, April, 1919.—Sufficient carbon monoxide may be produced by automobile engines to render the air of garages poisonous. This is particularly true of the small private garage which is poorly ventilated in winter. Tests made of the concentration of carbon monoxide present indicated as high as 3.2 per cent. after 35 minutes of running and 1.98 after 10 minutes. The extremely poisonous nature of such an atmosphere is evident from the fact that a few breaths of air with a concentration of 1.0 per cent. of carbon monoxide will cause collapse. The limits of gasoline vapor concentration are narrow. An engine running idle produces more carbon monoxide than when under a load; a retardation of the exploding spark, and the imperfect carburation of "warming up," all tend to render the small closed garage a serious danger.—H. W. Haggard.

On the Importance of De-Ionization in the Treatment of Plumbism in Queensland Children. *J. Lockhart Gibson.* The Medical Journal of Australia, April 5, 1919, 1, No. 14, 272-274.—A report of several cases of lead poisoning in children, treated successfully by Jones' method of electric baths, as described by Oliver (Lancet, Aug. 23, 1913, 2, No. 4695, 527). Both the patient's feet are placed upon a metal plate, and 20-40 milliamperes of a current of 7-16 volts are passed through his body, causing a deposition of lead upon the negative pole. All the cases reported were much improved clinically.—T. J. Putnam.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Some Unprotected Routes of Infection *George A. Soper.* Mil. Surgeon, May, 1919, 44, No. 5, 469-473.—Although much has been done to guard the soldier from infection, some routes of danger still remain unprotected against which he must protect himself. The infections considered are those of a respiratory type. Three main routes of infection are discussed: (1) Point-blank infection. This occurs when men talk to one another at too close range. As a measure of safety, one should step back or to one side when talking with a too earnest person, or, if possible, should speak over his neighbor's shoulder. (2) Medium-range infection. Here infectious matter is distributed throughout the atmosphere as a result of coughing, sneezing, or such thoughtless acts as the shaking of handkerchiefs. (3) Long-range infection. In this route infectious material spreads by means of articles handled by infected persons, coughed or sneezed upon by them, and subsequently handled by persons who are susceptible. The greatest danger here lies in the hands.—H. A. Bulger.

Pneumonia and Its Prevention. Wisconsin State Board of Health Bulletin, Jan.-Mar., 1919, 3, No. 5, 6-7.—Pneumonia must be classed among the infectious diseases. Owing to the high mortality rate, proper precautions must be observed in order to prevent initial break-down as well as to avoid infection from those already sick. The disease is more apt to break out in those who have become fatigued or whose state of health is low. It is believed that by observing the advice given here the number of pneumonia cases may be reduced and the mortality of the disease diminished.—L. A. Shaw.

On the Special Hazard from Certain Occupations for the Spread of Tuberculosis. Med. Klinik, 1917, 684; Centralbl. f. Bakt., 1te Abt., Referate, 68, 85, 1919.—Nurse-girls, domestics, teachers, school janitors and persons employed in food-manufacturing establishments can be especially dangerous as vectors in the spread of tuberculosis. They must, therefore, when possible, be caused to change their occupations. For

controlling this phase, regulations and laws are obviously necessary.—B. Cohen.

A NOTE ON THE EPIDEMIOLOGY OF INFLUENZA AMONG WORKERS. *A. Gregor.* Brit. Med. Jour., Mar. 1, 1919, No. 3035, 242.—There is a widespread belief that workers in fumes are immune from nasal catarrh and respiratory diseases in general. To test the truth of this, the author investigated nine gasworks, a cordite factory, and a tin mine. He tabulates his findings as follows:

	Percentage Summary of Case Incidence
Navy	40.0
Army	20.0
Cordite workers not in fumes	30.1
Cordite workers in fumes	4.7
Gas workers	6.7
Tin mine workers not in fumes (one epidemic)	60.8
Tin mine workers in fumes (one epidemic)	11.1

—T. J. Putnam.

THE EPIDEMIOLOGY OF INFLUENZA AMONG WORKERS. *E. J. Ball.* Brit. Med. Jour., Mar. 22, 1919, No. 3038, 358.—Consumption is practically unknown among copper smelters. In the old open-top iron blast furnaces, the men who worked at the top frequently got consumption, but not the tappers at the bottom. The author suggests that it is the sulphocyanide, not the sulphurous fumes, which produce the phenomenon, and suggests their therapeutic use.—T. J. Putnam.

INFLUENZA AMONG POISON GAS WORKERS. *Frank Shufflebotham.* Brit. Med. Jour., April 19, 1919, No. 3042, 478.—"The information with regard to influenza among poison gas workers has been collected from twenty different sources in different parts of the country; it all points in the same direction—that, with the exception of phosgene gas, workers engaged in the production of other poison gases have enjoyed a high degree of immunity from influenza infection. It is agreed, on the other hand, that phosgene workers are particularly susceptible to influenza, and that the disease, when contracted, assumes a serious course." The factories investigated manufactured chiefly sulphuretted hydrogen, chloro-picrin, chlorine, mustard gas, and phosgene.—T. J. Putnam.

A REPORT UPON THE USE OF ATROPINE AS A DIAGNOSTIC AGENT IN TYPHOID INFECTIONS. *H. Fairley Marris.* National Health Insurance Medical Research Committee, Special Report Series, No. 9, H. M. Stationery Office, London, 1917, pp. 50.—The author recommends the subcutaneous injection of 1/33 grain of atropine in patients suspected of having typhoid or paratyphoid fever, the pulse rate being counted by minutes for ten minutes before, and for ten consecutive minutes, twenty-five minutes after the injection. Any change of rate exceeding fourteen beats per minute, being that usually found, is considered a negative reaction; any less than this, positive. A positive reaction was found in 94 per cent. of 111 cases in the typhoid group, as shown by isolation of the organism. The test is more constant, the earlier in the disease it is tried; the error is about 10 per cent. during the first three weeks, rising to 100 per cent. after the ninth week.—T. J. Putnam.

TYPHOID MARY. *George A. Soper.* Mil. Surgeon, July, 1919, 65, No. 1, 1-15.—The author, who was responsible for the discovery of Typhoid Mary, the first typhoid carrier to be demonstrated, tells the complete story of her discovery, arrest and confinement, her subsequent escape, rediscovery and confinement up to the present time.—H. A. Bulger.

PRECAUTIONS FOR PREVENTING DANGER OF INFECTION FROM ANTHRAX, GREAT BRITAIN. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 243-245.—A British committee, appointed to investigate infection from anthrax, has reached the conclusion that any attempt to control anthrax by means of regulations is totally inadequate. The committee therefore recommends the establishment of central disinfection stations, the function of which shall be to disinfect the wool and hair before it reaches the factory.—L. A. Shaw.

ANTIVENEREAL-DISEASE AND SEX-HYGIENE PROGRAM FOR THE COLORED POPULATION. *R. C. Brown.* U. S. Pub. Health Ser., Pub. Health Rep., July 18, 1919, 34, No. 29, 1587-1593.—The report of the Surgeon General of the U. S. Army, 1918, shows that the ratio of venereal disease incidence of colored as compared to white troops is 2.8 to 1. Before the war little had been done to instruct the colored population or to offer them adequate treatment of venereal diseases. Unwholesome housing, lack of protective working conditions, lack of opportunities for recreation, difference in social pressure, and difference in self-control are also predisposing causes of the prevalence of venereal diseases in the southern belt.

The following program has been promulgated as a means of combating venereal disease:

A. *Medical—Clean out the Infections.* Neither the lack of facilities nor the difficulty of access to existing facilities should retard immediate and direct efforts to cure and control venereal disease. The prejudice against admitting colored patients to hospitals must be overcome.

B. *Law Enforcement—Clean up the Community.* Sporadic efforts must give way to definite effective action.

C. *Educational—Bare the Facts.* Propaganda should be distributed by all organizations having the personnel and the means to do so.

D. *Social Measures—Keep the Community Wholesome.* A trained body of social workers should control and direct the natural instincts for play and excitement.—L. A. Shaw.

HOW OHIO COMPARES WITH OTHER STATES IN VENEREAL DISEASE PREVALENCE. Ohio Pub. Health Jour., May, 1919, 10, No. 5, 195-196.—Four per cent. of the Ohioans among the second million men inducted into the army had a venereal disease. Two tables, one giving statistics for the states and the other for the cities, show the percentage of men inducted having a venereal disease.—L. A. Shaw.

Routine of the Department of Health's Venereal Disease Clinics. N. Y. City, Dept. of Health, Weekly Bull., June 28, 1919, New Series, 8, No. 26, 201-202.—The New York City Department of Health operates twelve advisory clinics and one treatment clinic. The advisory clinic, in addition to its original function as an educational center, has now taken over the diagnosis and placement for future treatment of the patients who apply. The clinic for free treatment receives only those patients who cannot afford even the small charge made by dispensaries.—L. A. Shaw.

The Management of Venereal Diseases in Egypt During the War. *James W. Barrett.* Proc. Roy. Soc. Med., January, 1919, 12, No. 3, 1.—The author, after analyzing his own experiences and those of other officers in charge of the African ports, has come to the regretful conclusion that moral advice and recreation have only a limited usefulness in the fight against the venereal diseases, and that prophylaxis, the more promptly applied the better, must be our chief reliance. He advocates the distribution, through reputable apothecaries, of prophylactic packages, containing 30 per cent. calomel ointment and 20 per cent. silver solution or jelly, with a circular of instruction and warning.—T. J. Putnam.

Control of Venereal Disease in Finland. *O. von Hellens.* Brit. Med. Jour., May 24, 1919, No. 3047, 651.—"The work of the 'Sanitätsburo'—the institution concerned with the supervision of the prostitute in Helsingfors—was much disturbed in 1917 by the revolution and strikes, and its operations on three occasions were more or less in abeyance. . . . The weekly attendances at the Sanitätsburo were . . . in 1916 between 200 and 250. This average was maintained early in 1917, but in the middle of March there was a sudden fall . . ., the period from the middle of March to the beginning of May being marked by few attendances and admissions to the hospital. But the fall in the notifications of gonorrhea in women at this period (which coincided with the first phase of the revolution in Russia) was followed by a considerable rise in the incidence of gonorrhea among men. . . . Ulcus molle followed the same curves as gonorrhea. . . . The figures for new cases of syphilis did not, however, coincide with those for gonorrhea and ulcus molle . . . because . . . the period between the infection and diagnosis is more variable, and often longer."—T. J. Putnam.

A New Way of Combating Venereal Diseases. *A. Blaschko.* Deut. med. Wchnschr., Jan. 2, 1919, 45, No. 1, 12-14.—The author pleads for a broad educational campaign; among doctors, in the early diagnosis and treatment of venereal disease; among the laity, in the natural history, recognition, and results of infection. The public campaign is to be chiefly through posters, one of which is shown.—T. J. Putnam.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Quarry Accidents in the United States During the Calendar Year 1917. Compiled by *Albert H. Fay.* U. S. Bur. Mines, Tech. Paper 213.—A statistical compilation.—H. W. Haggard.

Coke Oven Accidents in the United States During the Calendar Year 1917. *A. H Fay.* U. S. Bur. Mines, Tech. Paper 206.—A statistical compilation.—H. W. Haggard.

Metal Mine Accidents in the United States During the Calendar Year 1917. (With supplementary labor and accident tables for the years 1911 to 1917, inclusive.) *Albert H. Fay.* U. S. Bur. Mines, Tech. Paper 224.—A statistical compilation.—H. W. Haggard.

Miners' Safety and Health Almanac. For 1919. (Miners' Circ. 24.) Compiled by *R. C. Williams.* Published by U. S. Bur. Mines in cooperation with the U. S. Pub. Health Ser.—A compendium of public health advice and useful information on everyday subjects presented to the miner in the form of an almanac.—H. W. Haggard.

Teaching Safety in the Schools. *E. George Payne.* Safety Engineering, June, 1919, 37, No. 6.—The author recounts the methods used in Haries Teachers College, St. Louis, in the teaching of safety to school children. The methods used are very ingenious and the results attained appear highly valuable.—L. Greenburg.

Teaching Safety to Apprentices. *R. W. Tarbell* and *J. J. Metz.* Industrial Arts Magazine, April, 1919, 8, 143-145.—G. E. Partridge.

Safeguarding of Working Machines. Accident Preventive Supplement, American Industries, June, 1919.—This number summarizes the following principles to be adopted in the design of all machine safeguarding:

1. All power-working machines to have gears, sprockets, chains, belts, bands, pulleys, clutches, wheels, shafting, spindles, couplings, counterweights, revolving or reciprocating parts, and all other dangerous points, parts or projections guarded in approved manner.

2. All roller-fed machines on which operators' hands come within danger zone, to be guarded at the point of operation in approved manner.

3. All machines having a shearing, pressing, squeezing, or cutting action on which operators' hands come within danger zone, to be guarded at the point of operation in approved manner.

The requirements to be met by a safeguard, to be truly worthy of its name, should be:

(a) That it afford all possible safety to the operator and surrounding workmen.

(b) That it be, if possible, automatic in its action, application or operation.

(c) That it be, if possible, an integral part of the machine itself.

(d) That it do not materially diminish the output or efficiency of the machine to which it is applied.—L. Greenburg.

INDUSTRIAL SURGERY

Cineplastic Surgery and Prostheses. *M. Stassen.* Archives Médicales Belges, June, 1918, 71, No. 6, 655.—Cineplastic surgery is the art of modeling the bones and soft parts of amputation stumps in such a manner that the patient can move, voluntarily and directly with his own muscles and divided tendons, the different parts of his artificial limb (cinematic prosthesis). Vanghetti, an Italian physician, was the first exponent of the theory, toward the end of the last century. The method is particularly adapted to the upper extremity. French, English and American surgeons have paid little attention to the method, but there are over a hundred books and articles in Italian, German, Spanish and French upon the method and its results. A partial bibliography is given.

This issue of the *Archives Médicales Belges* also contains articles by Vanghetti, Pellegrini and Pieri upon the technique of cineplastic surgery.—T. J. Putnam.

Clinico-Statistical Contribution to the Study of Cineplastic Surgery. *Pellegrini.* Archives Médicales Belges, February, 1919, 72, No. 2, 43-121.—The author reports fifteen new cases, of which only three were not quite successful. The somatic attachment in all the others was painless, resistant, and capable of doing good work. The writer has come to prefer looped motors to bulbous ones, lateral motors to terminal, opposed motors to simple. He prefers tertiary cinematization of stumps, without interfering with the bone, to the reamputation employed by many surgeons; also, he has adopted the cutaneous plastic operation with bridged flaps, rather than that with pedicled flaps. He refers to Vanghetti's book, *La Vitalization des Membres Artificiels* (1916), and his own book on the subject, now in press at the Unione Tipografica Editrice de Turin.—T. J. Putnam.

Arm Prosthesis. *V. Putti.* Chirurg. d. organi di movimento, February, 1919, 3, No. 1, 122-130.—The device makes it possible for workmen who have lost a hand or a forearm to use the stump to perform certain work. A leather case carrying a small iron hook is passed over the stump. Leather strips strapped to the arm pass from the casing on the inner and outer side of the arm up to the shoulder. The shoulder girdle is used to steady the device—a leather strip passing from the shoulder across the chest under the arm of the opposite side and across the back to the shoulder. The hook enables the man to grasp objects and especially to carry considerable weights. The short article is accompanied by fifteen figures.—A. Allemann.

Late Effects of Injuries of the Head on the Ability to Work. *E. Fossataro.* Policlinico, May 25, 1910, 26, No. 21, 644-651.—Severe injuries to the head may only slightly or not at all affect the capacity for work, while injuries which at first appeared slight may result in great functional disturbances.

The author reports seventeen practical cases which were kept under observation for several years. In six cases the ability to work was reduced from 50 to 100 per cent. Of these, three had epilepsy; one, cerebellar ataxy; one, converging strabismus and slight ataxy; and one, hypertrophy of the left forearm and leg. In the other eleven workmen the capacity for work was reduced from 15 to 20 per cent. Lesions of the frontal region were relatively less grave, while a comparatively slight lesion of the occipital region resulted in one case in serious injuries. The author closes with the remark that in injuries of the head everything is possible and even the experienced practitioner has no means of ascertaining the extent of the injuries. His judgment, therefore, with regard to late consequences should always be guarded.—A. Allemann.

Traumatic Toxaemia as a Factor in Shock. National Health Insurance, Medical Research Committee, Special Report Series, No. 26. London: H. M. Stationery Office, 1919, pp. 47.—This report deals entirely with secondary shock, not with the primary shock which is apparently due to reflex inhibition of the heart and dilatation of the arteries. The subject is considered in a series of different papers by various members of the Special Research Committee, from both physiological and clinical points of view. A brief historical introduction by Wallace outlines the work that has been done on the subject to date.

Dale, Laidlaw, and Richards contribute a chapter on "histamine shock," the state of collapse following the administration of histamine, a derivative of histidine, a condition which they consider representative of that produced by other protein-split products. The effect of large doses of histamine on a healthy, normal animal, or upon one anesthetized with nitrous oxide and oxygen, is slight and temporary; but in an animal under ether, or in one which has lost a relatively small amount of blood, a much smaller dose causes a marked fall of blood pressure, decrease of blood volume, and death. The heart seems to be scarcely affected; the blood seems to be lodged in the capillaries. Applied locally, to the superficially scarified skin, histamine produces a wheal similar to that caused by a blow from a whip. The authors suggest that the products of tissue destruction, or of intestinal putrefaction absorbed through an injured mucosa, may cause similar symptoms.

The work of Bayliss and Cannon seems to corroborate this opinion. They found that a condi-

tion very similar to surgical shock could be produced in anesthetized animals by crushing large areas of muscle. It is prevented by cutting off the blood return from the injured limb, leaving the nerves intact. Massage of such injured muscles causes a further loss of blood pressure, which possibly explains the fact that shock is particularly apt to occur in cases of extensive fracture which are transported without proper splinting. An acidosis is often present, but is not an important factor. Bayliss has shown that the timely injection of a gum acacia solution, made up according to the directions which he gives elsewhere, will often ward off this experimental shock, if given in time. If the condition is allowed to persist until the respiration becomes irregular, apparently indicating injury to the bulbar centers, treatment is usually useless.

McNee, Sladden, and McCartney, in an analysis of a series of clinical cases, find that injuries to large areas of muscle, especially with hemorrhage, are oftenest associated with shock. In such cases the shock is often mitigated by early amputation. They have had as good results from the administration of gum acacia solution as with transfusion. Keith also reports several cases which were much improved by the use of gum acacia solution. He lays especial stress upon the diminution in blood volume, and the use of hemoglobin determinations as a guide to treatment.

Mott gives a brief account of the changes in the central nervous system occurring in various forms of shock. The brains, in gross, were wet and microscopically there was vascular stasis and dilatation of the periadventitial and perineuronal spaces. Some evidence of slight fat embolism was found in one case. The nerve cells showed a chromatolysis, apparently due to the anoxemia. In addition, the changes in staining reaction suggested some biochemical change in the cell.—T. J. Putnam.

FATIGUE AND OCCUPATIONAL NEUROSES

The Physiology of a Working Day. Editorial, Brit. Med. Jour., March 29, 1919, No. 3039, 386.—During the discussion on the second reading of the Ministry of Health Bill, Major H. C. Farquharson, who has spent many years of practice in the service of the miner, expressed his astonishment that the number of hours that a man should work was to be settled by the arbitrary, capricious decision of the masses. He contended that it was a scientific problem, and suggested that if science could establish that a normal man could work up to a given standard without injury to his health or his chances of longevity, the number of hours of a working day could be standardized; and that there ought to be a scientific department, working in relation with the Ministry of Health, to decide various matters of a physiological nature in regard to capital and labor, including hours of work. Much scientific work has been done in this direction, a good deal of which is summarized in the report of the Health of Munition Workers' Committee; but the subject is complex, and physiology is far from having found a complete solution. Dr. H. M. Vernon's report to this committee that the hours of labor ought to be varied between wide limits according to the character of the work performed seems to indicate the most promising line of inquiry.—T. J. Putnam.

Hours of Work as Related to Output and Health of Workers—Silk Manufacturing. Nat. Ind. Conference Board Pub., Research Report No. 16, March, 1919.—This is the third of a series of reports on the textile industries. As in the case of its predecessors the data utilized were obtained by schedules of inquiry "supplemented by reports of field agents who visited a large number of mills." It is not possible, however, to separate the data gathered by questionnaire from data gathered by direct examination. One cannot fail in the impression that the former method was responsible for most of the material analyzed in the report. This is notably true of the section purporting to deal with the health of silk-mill workers. Again as in the case of the report upon wool workers, reviewed by the authors in a previous number of this journal, there is no effort whatsoever at medical analysis of health conditions in silk mills as they now exist. The report speaks of a lack of satisfactory records for analysis and then goes on to make use of data derived from publications of the United States Bureau of Labor Statistics, the Prudential Life Insurance Company, and a bulletin of the Department of Industry and Labor in Italy. The National Industrial Conference Board mentions the fact that it has induced a substantial number of establishments to keep careful records of absenteeism in industry over twenty-four-day periods in the summer of 1918 and another which has apparently been kept during the past winter. These records, it is acknowledged, will show little regarding the effect of hours of work on health, but may encourage the keeping of permanent records of similar character from which valid conclusions as to the effect of hours of work on the health of silk-mill employees may be drawn. We doubt very seriously whether the study of records will ever result in other than misleading conclusions. Such study must in all instances be accompanied by very thorough hygienic surveys of the industry in question. Surveys of typical establishments in the hands of highly competent men could do much toward establishing the real reason for the high tuberculosis incidence among silk workers. Studies of records and of data gathered through questionnaires can never meet the needs of the situation. It is again much to be hoped that the National Industrial Conference Board will be able to secure so high a degree of co-operation from manufacturers that a thorough medical analysis of the work in question may be secured. One cannot fail to feel that the present type of report simply exists as a preliminary and unsatisfactory exposition of the field of silk manufacturing, which is quite unworthy

of the organization which has published it.

Research Report No. 16 opens with a very readable summary of the processes involved in silk manufacturing. Eighty-four establishments situated in Pennsylvania, New Jersey, Connecticut, New York, Massachusetts, Maine, and Maryland are covered. Hours of work in these factories varied between fifty and fifty-five per week, and were fifty hours in practically two-thirds of the establishments studied. The reductions in hours of work which were examined vary from a maximum of five to a minimum of two. As the fifty-hour week is now apparently the true working week in the silk industry, conclusions are presented bearing directly upon it. "The experience with a fifty-hour week in the silk industry presented in the preceding discussion shows clearly that such a schedule has, in a great majority of instances, been accompanied by loss in output. For fifty-eight establishments reporting results secured with such a work-week, only nine maintained the production previously secured with longer schedules; in two of these nine establishments there was an increase. On the other hand, twenty-three establishments, employing more than one-half of the total workers included in the fifty-hour group, reported a loss in output somewhat less than proportional to the reduction in hours. Only one establishment reported a loss more than proportional to the reduction in time. In nineteen establishments, or about one-third of the total number, the loss was reported as about proportional." Maximum production in the industry, as experience now stands, is reached somewhere between the fifty and fifty-four-hour week. Silk manufacturing is less mechanical than the cotton or wool industries, which accounts for the fact that reduction in hours has not been so hard upon production as in them.

The report thus presents a summary of hours of work as related to output. Some attention is paid to the question as to whether the processes involved are really sensitive for such analysis, but there is none of the extensive discrimination in this regard which has been advocated by Florence. From such a publication one hopes to gain two things.

1. Do shorter hours hurt production?

This point seems adequately answered in so far as immediate results are concerned.

2. Do shorter hours result in sufficient alteration of the physical well-being of the workers to insure permanent production at or above the new level attained?

No real evidence is available upon this point. Six establishments reported an appreciable improvement in the health of workers on a fifty-hour schedule, but no facts are presented as to the character of this evidence. We may again hope that, at least so far as the question of health is concerned, the National Industrial Conference Board will consider this but a preliminary report and that at a later date we shall have real evidence as to health conditions in the silk industry. —David L. Edsall and Cecil K. Drinker.

Reducing the Hours of Work. Policlinico, June 22, 1919, 26, No. 25, 781-785.—Long working hours produce in the worker a condition of chronic fatigue which gradually affects the quantity and quality of work. Chronic fatigue is the cause of numerous morbid processes: varicose veins, flat foot, cramps, neuritis, myositis, hypertrophy and dilatation of the right heart, digestive disturbances, anemia, neurasthenia, etc. We must, however, distinguish between the different kinds of work. A miner or a worker in a chemical or metallurgical establishment will much sooner experience fatigue than a farm laborer. The chief objection to reduced working hours is a diminution of production, but the medical man cannot recognize this objection where the well-being of a whole people is at stake. But in some industries, as in the Zeiss establishment in Jena and in the coal mines of Austria, it has been demonstrated that production may be increased by reducing the working hours. As to extra work which is always paid higher, it should be granted, but only under exceptional conditions, and to a limited extent. It is said that a large amount of free time will increase alcoholism among workmen, but this can be guarded against by proper laws.—A. Allemann.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Resuscitation from Electrical Shock by the Prone Pressure Method. Safety, June, 1919, 7, No. 5, 114-120.—An historical sketch of the rules for resuscitation, of which the first were formulated in Holland in 1767, leads up to a description of the latest rules recommended by the Third Resuscitation Commission, as revised and issued by the National Electric Light Association.

These rules are listed under the following headings:

1. Free Victim from Circuit Immediately.
2. Attend Instantly to Victim's Breathing.
3. Send for a Doctor.
4. First Care for Burns.

—G. M. Fair.

A Contribution to the Technic of Artificial Respiration in Man. *G. N. Stewart* and *J. M Rogoff* Jour. Lab. and Clin. Med., November, 1918, 4, No. 2, 73-76.—The attempt to resuscitate a person apparently dead from electric shock should be begun at once by a manual method, such as the prone-pressure method, which should be taught to every workman in the least likely to need it. The advantage of supplementing this later on by some simple mechanical device has been emphasized by Meltzer and others. Meltzer's arrangement, which he considers superior to the elaborate and expensive devices put on the market commercially, consists of a foot-bellows, a rubber bag to equalize the pressure, and a valve opened

and closed by hand. He uses a pharyngeal tube, but the authors prefer a close-fitting mask, as being more easily applied. They also describe a simpler valve, to be fastened to the mask and make one or two other minor recommendations as to technic.—T. J. Putnam.

WOMEN AND CHILDREN IN INDUSTRY

Japanese Women and Girls in Industry. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 229-230.—Almost two-thirds of the factory workers of Japan are women and girls. The conditions in the factories are deplorable. Hours of work range from thirteen to sixteen hours per day, with apparently no age limit for children. Living conditions are sickening. Of the 200,000 persons recruited each year, 120,000 eventually meet physical or moral ruin.—L. A. Shaw.

Effect of the Third Year of War on Industrial Employment of Women and Girls. *A. M. Anderson*. Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1916, p. 5-10.—The events of 1916 have widened the altogether new industrial position and outlook for women. The substitution of women for men in many industries has progressed to a point where far-reaching effects are to be looked for in the national life. This phase has become so systematized that a guide has been prepared for the National Service Department showing the trades and processes and the conditions under which substitution of women and girls is advisable or possible from the points of view of efficiency and of health. It appears that one absolute limit to the replacement of men by women lies in those heavy occupations and processes where adaptation of the plant or appliances cannot be effected so as to bring them within the compass even of selected women of above normal capacity.

As regards the health of the women, it seems difficult to estimate how far, if at all, heavy work causes any physical injury, as there is no record of women who give up or their reasons for doing so. It appears that in all outdoor laboring the health and appetite of the workers is greatly improved by work in the open air.

A new difficulty has arisen in that it has become very hard to replace the women who have left the so-called women's industries to take a hand in the work formerly done by men. The national gain appears great in the new self-confidence engendered in women by the large number of cases where they efficiently do men's work at men's wages. If this new valuation can be reflected in their own special occupations, a renaissance may there be effected of even greater significance than the immediate widening of women's opportunities. Undervaluation there in the past has been the bane of efficiency.

A preliminary survey of factories where women were employed, covering 1396 plants with 198,661 women and girls, was made with special reference to the question of welfare. The plants were roughly classified into three classes. It was found that 31 per cent. were in class A, 49 per cent. in B, and 20 per cent. in C. B and C conditions meant, in varying combinations, partial or complete lack of mess-room accommodations or facilities for cooking food; inadequate or non-existent cloak rooms and washing appliances; lack of a supply of seats; need of first-aid and rest rooms; supervision even of numerous girls by men only, and other defects, in factories mostly working twelve-hour shifts. This investigation resulted in the appointment of welfare directors for individual plants, and marked improvement followed in the main. In some plants the employees took the initiative and supported their own welfare committees, who furnished, with money subscribed by the employees, a variety of features as desired by the workers.—B. Cohen.

English Working Women During the War and After. U. S. Bur. Labor Statis., Month. Labor Rev., May, 1919, 8, No. 5, 236-243.—A report from the Board of Trade Journal (London) for March 6, 1919. A table gives the number of women employed in certain essential industries on July, 1914, compared with the number in the same industries July, 1918. Dr. Rhoda Adamson was put in charge of the medical supervision of several thousand women engaged in various processes of engineering work, formerly considered a man's work. She studied the different operations which the women were called upon to perform, so that every woman might be thoroughly examined with a view to her physical fitness to perform the particular work to which she was assigned. Dr. Adamson was also able to determine, through successive examinations, the changes of health—if any—which might be attributed to occupational strain. As a result of two years' experience, she concluded that, provided care is taken in assigning women to work suited to their strength, they can perform, without risk, the engineering operations which were formerly regarded as beyond their power.

The rest of the report is a survey of the post-war outlook for women in non-munition factories in England, and the demands of English working women.—L. A. Shaw.

Standard Working Conditions for Women in California Laundry and Manufacturing Industries. U. S. Bur. Labor Statis., Month. Labor Rev., May, 1919, 8, No. 5, 232-235.—An extensive and detailed order of twenty-six articles promulgated by the Industrial Welfare Commission of the state of California, prescribing standard conditions of employment for female workers in laundries and manufacturing industries throughout the state.—L. A. Shaw.

Recent Orders by British Columbia Minimum Wage Board. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 207-208.—By the provisions of the Minimum Wage Act of British Columbia, a minimum wage board

was constituted. From August, 1918, to March 31, 1919, six orders were issued by the board, all relating to wages of women engaged in the mercantile, laundering, cleaning, and dyeing industries. These laws fix the minimum wages for women over 18 years of age, for those under 18 years, and establish various scales for apprentices.—L. A. Shaw.

Employment of Women in Acetylene Welding. *Helen G. Fisk.* U. S. Bur. Labor Statis., Month. Labor Rev., May, 1919, 8, No. 5, 221-230.—A comprehensive survey of the acetylene welding process with special reference to the adaptability of women to such work. Working conditions for women welders vary greatly with the individual concern, but despite the hazards of the occupation, welding is an attractive field for women. The work is interesting and always presents the worker with opportunities to increase her skill. The pay received is considered good. Nine and nine and one-half-hour days prevail. For light welding work women are in all respects equal to men.—L. A. Shaw.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

A Plan to Aid and Advise Prospective Manufacturers Before They Construct Their Plants. Safety, June, 1919, 7, No. 5, 114-120.—The Engineering Division of the State Department of Labor of New York has issued a blank form (E159) on which preliminary studies and specifications of proposed buildings, alterations, and so forth, may be sketched and submitted to the division for examination and criticism. This service is rendered by the State Industrial Commission in order to obviate the necessity of structural changes in a completed structure, when upon inspection by the Labor Department it is found that buildings or alterations do not conform to the requirements of the Labor Law and the Industrial Code.—G. M. Fair.

Scientific Lighting and Industrial Efficiency. Engineer, Aug. 1, 1919, 128, No. 3318, 122.—In a lecture on *Scientific Lighting and Industrial Efficiency* delivered at the British Scientific Products Exhibition, Westminster, on July 28, Mr. Leon Gaster pointed out the close relation existing between good industrial lighting and the health of workers, and gave many instances of accidents due to insufficient or badly arranged conditions of illumination. Light, he said, was a *tool*, and it was absurd to install expensive machinery and to pay highly skilled workmen, and then to neglect the relatively small expenditure on illumination necessary for the efficient performance of work. Instances were quoted showing that, as a result of improved lighting conditions, increases in output of 8 to 10 per cent. had been recorded. Another factor of importance was the reduction in the amount of spoiled work.

The cost of lighting formed only a small proportion, in some cases less than 1 per cent. of the wages bill. Good industrial lighting was therefore amply justified on economic as well as on humanitarian grounds.—G. M. Fair.

Industrial Lighting. *C. E. Clewell.* Jour. Franklin Inst., July, 1919, 188, No. 1, 51-90.—While no attempt is made in this extensive paper to give a scientific analysis of factory lighting from the quantitative side, the author gives an excellent general outline of the factors involved in the problem. The engineering details of both natural and artificial lighting are discussed, costs are analyzed, and accidents are considered.—G. M. Fair.

Law and Ventilation. Domestic Engineering, July 5, 1919, 88, No. 5, 8.—A brief discussion of the legal liability of employers for lack of ventilation.—G. M. Fair.

Water Supplies and Drinking Devices—How They May Spread Bacterial Diseases. *W. D. Stovall* and *F. R. King.* Wisconsin State Board of Health Bulletin, January-March, 1919, 3, No. 5, 14-19.—A classification of drinking waters as safe or unsafe according to the source from which they arise. Drinking waters as carriers of bacterial diseases and the drinking devices which must be condemned, on this account, are here considered. Recommendations for hygienic drinking devices, and reference to illustrations of them are included.—L. A. Shaw.

Standards for Factory Washroom Facilities. *L. A. Coolidge* Dom. Engin., Aug. 9, 1919, 88, No. 6, 253-254.—A discussion of the standards for factory washroom facilities recommended by the Welfare Division of the Committee on Labor, a part of the Advisory Commission of the Council of National Defense.—G. M. Fair.

Sanitary Equipment for Industrial Buildings. *C. L. Hubbard.* Dom. Engin., July 19, 1919, 88, No. 3, 100-102, 141.—Suggestions for securing contracts for the installation of modern plumbing in factories and for arranging the sanitary equipment in a large plant.—G. M. Fair.

Efficient Control of Small Sewage Treatment Works. *J. H. Edmonson.* Munic. Eng., July, 1919, 57, No. 1, 21-22.—In the control of small sewage treatment works, as in the control of large ones, efficiency in combination with economy is the goal to be arrived at. The author describes such matters entering into the proper control of small plants as measurement of sewage flow, measurement of sludge, refined and approximate analyses, and some simple tests.—G. M. Fair.

Control over Factory Wastes in Wisconsin. Engin. N.-Rec., July 24, 1919, 83, No. 4, 159.—For the control of the treatment of industrial wastes in Wisconsin, the State Board of Health

has prepared a list of requirements for the construction and operation of plants for treating various classes of wastes. A copy of these requirements is submitted to each concern installing a waste-treatment plant for signature by a responsible official. Of the two witnesses to the signature, one must be the local health officer.—G. M. Fair.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Housing Plans That Workers Like. System, August, 1919, 34, No. 2, 212-216.—A brief popular statement concerning several successful housing schemes. The account suggests some essentials regarding the value of housing schemes to workers, the establishment of restrictions, size of houses, and methods of sale.—C. H. Paull.

Housing Policy for Ontario, Canada. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 294-297.—The shortage of Canadian workmen became so acute, as a result of the war, that the Ontario government appointed a committee to make a report on housing conditions. The committee concludes that the ideal housing policy is to be found in co-operative construction and control, combined with municipal and governmental provision of loans at the lowest rate of interest. Recommendations are made for an equitable system of taxing land.

As an intimate part of the housing problem, it is suggested that town planning be made obligatory for all urban municipalities in the province. Plans and specifications for laborers' cottages should be available upon application. The committee also makes certain suggestions in regard to the type of house for the building of which the state is ready to render its aid.—L. A. Shaw.

The New London Housing Project. *L. L. Tribus.* Munic. Jour. and Public Works, Aug. 16, 1919, 47, No. 7, 102-104.—A general description of the housing development of the United States Housing Corporation at New London, Connecticut.—G. M. Fair.

The Question of Workmen's Lodgings in Lille After the War. *A. Calmette.* Rev. d'hyg., Jan., 1919, 41, No. 1, 17-31.—The destruction of large numbers of dwellings in Lille during the war will work a great hardship when the fugitives return there. The first step which has been taken has been the limitation of the number of people who may live in each house. Temporary wooden villages should be erected in the city and the suburbs; houses for families, and barracks for single men. The municipality should finance these buildings, and then let them at a rate which will repay the entire expense within ten years. It should then be possible to plan out the future development of the city along the most approved lines.—T. J. Putnam.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

State Wide Health Survey. Bull. N. Y. State Ind. Com., June, 1919, 4, No. 8, 175.—An announcement of the proposed plan for making a survey of sanitary and health conditions in large industrial plants in the state. This survey is being conducted co-operatively by the State Department of Health and the State Industrial Commission.—C. H. Paull.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

Mental Tests. *Shepherd I Franz.* Ment. Hyg., April, 1919, 3, No. 2, 258-265.—A review of the methods of mental examination from phrenology and "sizing a person up" to the modern scientific tests of intelligence. By most employers the practical test has been used. "A manufacturer hiring a machinist may determine his competency by finding out, if the applicant tells the truth, what kinds of positions he has previously held, or he may determine it in a very practical way by getting the applicant for a job to show his ability at a lathe or other machine to which he may be assigned. Or the builder hires a bricklayer, and pays him while his competency is being determined. Such practical tests are, however, expensive. They risk costly machinery and materials, and if an unskilled man be permitted to try to do work for which he has no competency he may endanger the lives of others as well as his own. Tests have been devised so that the ability of a machinist, for example, may be determined without the danger of loss of material, destruction of tools, and the payment of wages." The paper is a transcription of a part of Dr. Franz's Book, *Handbook of Mental Examination Methods*.—S. Cobb.

Age Scale Methods of Measuring Intelligence. *R. C. Moore.* Jour. Exper. Ped., June 5, 1919, 5, No. 2, 78-97.—This is a study of the validity of the current methods of measuring intelligence. There is a brief but useful historical outline of the methods, and a report of a statistical study made with 389 children for the purpose of comparing the results of Binet's 1908 series, Binet's 1911 series, and Goddard's series. The

conclusions have a value for the general theory of tests. The mental ages derived from the use of Binet's 1911 scale most closely resemble the corresponding physiological ages. Goddard's series ranks second in this respect.—G. E. Partridge.

An Absolute Intelligence Scale: A Study in Method. *G. Arthur* and *H. Woodrow*. Jour. Applied Psychology, June, 1919, 3, No. 2, 118-137. —G. E. Partridge.

"Cross-out" Tests, with Suggestions as to a Group Scale of the Emotions. *S. L. Pressey* and *L. W. Pressey*. Jour. Applied Psychology, June, 1919, 3, No. 2, 138-150.—A summary of the work of the classification division of the Adjutant General's department, containing an account of the army personnel organization, classification of soldiers, soldiers' classification card, trade specifications and occupational index, trade tests, tables of occupational needs, personnel specifications, classification and rating of officers, the rating scale, the rating-card scale, relations with the field, the recruit-receiving building.—G. E. Partridge.

Measuring a Workman's Skill: The Use of Trade Tests in the Army and Industrial Establishments. *W. V. Bingham*. National Society for Vocational Education, Bulletin No. 30, June, 1919, 7-17.—The development of trade testing has been one of the useful by-products of the war. Although we had acknowledged that waste of human life and skill by misplacement of men is a costly extravagance, it required the stress of war to make us act on this conviction. The scientific method brought from the laboratories into the service of the army will now find enlarged application to important problems of human adjustment in industry. The tests used in the military service were based upon an analysis of the occupation. This analysis determined the test questions or processes, which were later calibrated by their application to men whose degree of proficiency was already known. Two important facts were discovered. The first was the rarity, indeed the non-existence, of the exclusively motor-minded type of tradesman, the man who can do the work but who cannot tell how it is done. The second was that, in the majority of the trades, the oral tests yielded more accurate differentiations of proficiency than did the performance tests. In other words, the journeyman and the expert differ from the apprentice not so much because they have greater manual skill and dexterity as because they excel in judgment, technical information or trade knowledge.—G. E. Partridge.

Mental Tests for Prospective Telegraphers: A Study of the Diagnostic Value of Mental Tests for Predicting Ability to Learn Telegraphy. *L. L. Thurstone*. Jour. Applied Psychology, June, 1919, 3, No. 2, 110-117.—This investigation was undertaken to determine whether it is possible to predict ability in telegraphy by mental tests. The persons examined were 165 drafted men of Class A who registered for a night course in radio-telegraphy at the Carnegie Institute of Technology. The tests employed were: rhythm test, opposites tests, analogies test, Gordon directions test, Trabue completion test, spelling test, arithmetic test, sentence test. The conclusion reached by studying the correlations with the highest receiving speed attained during the first 100 hours of practice is that ability to learn telegraphy is a special ability. It is not closely correlated with general intelligence nor with education. The rhythm test proved to be by far the most diagnostic of ability and showed a zero-order coefficient of 0.48, which was not noticeably increased by the addition of four of the best general intelligence tests. A vocational survey of students in a radio-mechanics course showed, on the other hand, that schooling is one of the best diagnostic criteria in selecting men to be trained in the care and repair of wireless apparatus.—G. E. Partridge.

Air Service Tests of Aptitude for Flying. *V. A. C. Henmon*. Jour. Applied Psychology, June, 1919, 3, No. 2, 103-109.—This is an account of the use of psychological tests in the selection of men for the Air Service, where obviously the determination of ability in advance of practical training is of the highest importance. Study of correlation of tests with reports from the flying school shows that tests of emotional stability, perception of tilt, and mental alertness were of most value. The composite score obtained from the series of tests recommended gives a multiple correlation coefficient of 0.70, which the writer thinks is a sufficient basis for confident prognosis of ability. —G. E. Partridge.

The Proof or Disproof of the Existence of General Ability. *G. H. Thomson*. Brit. Jour. Psychology, May, 1919, 11, Nos. 3 and 4, 320-336.

The Hierarchy of Abilities. *G. H. Thomson*. Brit. Jour. Psychology, May, 1919, 11, Nos. 3 and 4, 337-344.

General Ability, Cleverness and Purpose. *J. C. M. Garnett*. Brit. Jour. Psychology, May, 1919, 11, Nos. 3 and 4, 345-368.—This and the above two papers, too mathematical in form to allow a brief review, all deal with phases of the problem of *general intelligence*. They are important from the standpoint of the theory of mental tests.—G. E. Partridge.

INDUSTRIAL HEALTH LEGISLATION AND COURT DECISIONS: MALINGERING

A New Malingeroscope. *E. M. Alger*. Am. Jour. Ophth., Feb., 1919, 2, No. 2, 112-114.—This device purposes to establish the actual vision in each eye. It consists of two short parallel cylinders arranged opera-glass fashion. The distal end of each tube is covered by a cap which can be

rotated, and contains a 6 mm. aperture, eccentrically placed. Through rotation of the caps it is possible to vary the distance between the apertures (lying always in the same horizontal plane) from 45 mm. to 70 mm. The patient looks through this apparatus at two ordinary test cards, 20 feet away, about 18 inches apart. The apertures just cover the width of one card, but both cards cannot be seen at the same time with either eye alone. When the apertures are approximated to considerably less than the interpupillary distance, both cards are seen at the same time, but the right-hand card is seen only with the left, and the left-hand card only with the right eye. If the malingerer is asked to read the right-hand card through the right-hand opening he is apt to think he is using his right eye when he is really using his left eye.—A. Allemann.

INDUSTRIAL MORTALITY AND MORBIDITY STATISTICS

Monthly Statement of Coal Mine Fatalities in the United States for January and March, 1919. *Albert H. Fay.* U. S. Bur. Mines. —A compilation of coal mine fatalities listed by states and causes; includes also additions to the list of permissible explosives and mine appliances. —H. W. Haggard.

Influence of the War on Accident Rates in Machine Building. *Lucian W. Chaney,* U. S. Bur. Labor Statis., Month. Labor Rev., April, 1919, 8, No. 4, 12-21.—The author gives tables from which he draws conclusions regarding the effect on accident rates of the great intensification of industrial effort incident to the war. The first seven tables show the number of accidents and accident frequency rates in various industrial plants before and during the war. The upward trend of severity rates in machine building concerns, compared with a declining severity rate in the navy yards, can only be explained by the exercise of skill and energy on the part of the safety engineers in direct charge of the navy yards. The reason for fluctuations in accident rates is not yet satisfactorily answered, but all available data indicate that it is due, more than to any other factor, to the introduction into the working force of relatively inexperienced men. A "ratio" chart giving the rate of change in four related items—employment, product per worker, labor recruiting, and accident rates—shows that the curve of accident frequency follows that of labor recruiting with surprising promptness, and that increased product per worker is less of a controlling factor than recruiting.—L. A. Shaw.

Physical Examination of Employees, Giving Statistics of Examination of Employees of the Department of Health. *Maude Glasgow.* Month. Bull. Depart. Health, City of New York, April, 1919, 9, No. 4.—The Welfare Division of the Department of Health has now entered upon the fifth year of its existence. The general scheme of its methods is described, and a table of the findings on physical examination of 1,534 persons during a year is given.—T. J. Putnam.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME 1 NOVEMBER, 1919 NUMBER 7

CONTENTS

GENERAL

PUBLIC HEALTH IN THE INDUSTRIAL AGE. *P. Geddes.* The Sociological Review, Spring, 1919, 2, No. 1, 49–61. — This is one of the chapters of the first volume of Professor Geddes' *Report to the Durbar of Indore.* The report as a whole is the result of a prolonged study of the city of Indore, the capital of one of the native states of India, and includes (1) the history of the city, (2) the effects of its growing industrialism in producing overcrowding, disease, and other well-known results, and (3) projects for betterment in the immediate and in the more remote future. This report is one of several made by Professor Geddes, who for five years has been studying the industrial conditions in the cities of India.

Professor Geddes discusses briefly in this paper several fundamental points of civic hygiene. He criticizes the practice, so common in large cities, of demolishing old buildings without previous attention to providing new ones, and maintains that this has been no small factor in making decent houses pass beyond the means of the people in every city. The relation between occupation and disease, the writer remarks, is often to be found through a third term — bad housing. As soon as we improve the housing conditions, we find relief from the diseases of occupation. Town planning is defined as not a new specialization, but as the returning co-ordination of several branches toward civic well-being. It is the civic aspect and application, in its broadest conception, of the higher and more general level of public and personal thinking which has long been arising here and there. Diseases are many, but health is one. To find co-ordinating principles of health and to establish general conditions that will produce health, is one of the great works of future medicine. The problem of increasingly insuring city health becomes a great and far-reaching one. Every specialist has been contributing his point of view; now the time for co-ordination has come. Pure food, pure air and pure water are concepts that must be emotionalized. We must conceive of diseases not in the terms of the developing life, but in terms of the depressed life which our sanitarians, learned and specialized pathologists as they are, do not as yet broadly discern or explain, do not envisage, cannot yet handle.

A brief review fails entirely to convey the unusual quality of this article. It ought to be read by every hygienist. — G. E. Partridge.

Royal Institute of Public Health. Report of London Conference, June 25, 1919. Lancet, July 5 and 12, 1919, 197, Nos. 5001 and 5002, 15–18, 60–63. — This report contains a discussion of the work of the new ministry, the prevention and arrest of venereal disease, housing in relation to national health, maternity and child welfare, and the tuberculosis problem. — J. C. Aub.

Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1917. Parliamentary Paper, Cd. 9108, 1918, pp. 24. — After twenty-one years as Chief Inspector of Factories and Workshops, Sir Arthur Whitelegge retired on reaching the age limit in 1917. The current annual report is signed by H. M. Robinson, his successor.

Aside from routine duties, interesting developments have arisen out of conditions created in industry by the war. T. N. T. poisoning has been successfully attacked and a notable reduction in the number of cases has resulted. Special inquiries have been also instituted into the effects of ether and alcohol fumes on the workers making cordite, and into cases of arseniuretted hydrogen poisoning connected with the manufacture of coal tar dyes. The output of aeroplane factories has been much facilitated by the attention directed to the proper ventilation of the doping rooms, where poisonous fumes are produced.

A new feature, due to the shortage of male labor, is the employment of women in electric power plants. In a few sub-stations women have even been in sole charge of the operation of the plant, including the running of the generators with the accompanying switching and regulating duties. It appears, however, that in general the work of the sub-station attendants is more suitable for men, and schemes are in operation for the training of disabled soldiers and sailors for the work.

The enforcement of welfare conditions in factories has become part of the ordinary duty of the factory inspectors under the Miscellaneous Provisions Act of 1916. Conferences with employers' and workers' representatives have been held to discuss criticisms and suggestions which had been submitted, and before the end of the year orders were issued requiring the provision of (1) protective clothing and cloak and messroom accommodations in factories in which tin plate is manufactured; (2) a supply of drinking water in all factories and workshops where twenty-five or more persons are employed; and (3) first-aid boxes and, in some cases, ambulance rooms in blast furnaces, iron mills, and other metal works. [Ambulance rooms are the equivalent of our emergency hospitals.]

The following special reports are appended to the Annual Report of the Chief Inspector:

Hours of Work and Emergency Orders, by Mr. G. Bellhouse, Deputy Chief Inspector.

Extent and Effect of Substitution of Women and Girls in Industry, by Miss Anderson, Principal Lady Inspector.

Doping in Aircraft Works, by Mr. S. Smith, Dangerous Trades Inspector.

Trinitrotoluene Poisoning, by Dr. Legge, Senior Medical Inspector.

— Barnett Cohen.

The Labor Situation in France. *N. Swartz.* Bull. N. Y. State Ind. Com., July, 1919, 4, No. 10, 191. — In her comments on a recent visit to France, Miss Swartz calls attention to the fact that the heavy work in munition factories during the war has made many women workers unfit for their former occupations where deftness of touch is essential. She calls attention also to working conditions in French factories where machinery is generally less carefully guarded than in this country. On the other hand, the writer found a certain lack of the tenseness which is so characteristic of our American factories. — C. H. Paull.

Resolutions of the American Federation of Labor on Scientific Research. Science, July 4, 1919, 50, No. 1279, 15. — The American Federation of Labor, in convention assembled, has resolved that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the federal government, and that the activities of the government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended. — G. M. Fair.

The Educational Program of American Labor. From American Labor's Greatest Convention. American Federationist, August, 1919, 26, No. 8, 604–605. — At this convention of American Labor, commendation was given to the various states which have enacted continuation-school laws, and to the labor movement of those states for the part they played in securing such legislation. Support was urged of various recommendations, among which were the following:

1. Establishment of more adequate methods of vocational guidance in our schools, to meet the increasing demands.
2. Simplification of courses of study.
3. Drastic reduction in the prevailing size of classes.
4. Diversified training in the upper years of the elementary school.
5. Instruction in the privileges and obligations of intelligent citizenship.
6. The use of the English language as the basic language in instruction, and the provision of adequate facilities for teaching English to non-English speaking people.
7. Extension of playground facilities and continuation of medical and dental inspection.
8. Better enforcement of laws for compulsory education.
9. Wider use of the school plant to secure increased returns to the community through additional civic, social, and educational services, and public forums.
10. The introduction of the metric system into this country.
11. Thorough revision of the salaries of teachers, to meet the increased cost of living and the growing appreciation of the value of teachers' services.
12. A more liberal increase in school revenues.

The convention emphasized the fact that men and women in becoming teachers do not thereby surrender their rights as American citizens, and that the right of teachers to affiliate with organized labor must not be interfered with in any way. Representation of organized labor on all boards of education was deemed essential to the best interests of our schools, school children, teachers and the public

generally. The Executive Council of the American Federation of Labor and all state and local central bodies were urged to give every possible support to the American Federation of Teachers in the work of organizing the teachers of our country. — G. E. Partridge.

THE NEW EDUCATION AND THE NATION'S BUSINESS. *G. L. Swiggert.* School and Society, August 23, 1919, 10, No. 243. — The writer presents a picture of a far broader commercial life in our country than has hitherto been reached, and emphasizes the need of a correspondingly wider conception of business training as commercial education. This training should begin before the secondary school and should include not only geography, history and language, with reference to commercial use, but also instruction in the elementary business operations of factory and office. — G. E. Partridge.

TEACHING IN BRITISH CONTINUATION SCHOOLS. A circular issued by the Board of Education. School and Society, August 23, 1919, 10, No. 243, 237–238. — This is an appeal, under nine topics, for support of the idea of the continuation school as a new departure in education, as provided by the Education Act of 1918. By this act all youths from 14 to 16 years of age, who do not attend regular schools, must attend continuation schools, for which time must be set apart in the day — one whole day, or two half-days in each week, or an equivalent amount of time arranged according to the plan adopted in any particular locality. An appeal is made to the public to become interested in this work, and likewise to all who have qualifications to direct their talents to the work of teaching in this field. — G. E. Partridge.

THE PITTSBURGH CO-OPERATIVE PLAN. *E. Rynearson.* The School Review, September, 1919, No. 7, 533–544. — Two high schools of Pittsburgh have been experimenting with part-time courses, the pupils of which are engaged in commercial occupations. It was discovered that practically the same amount of work was done in school as in former years. The alternate-week plan has been found on the whole most satisfactory. Many new problems have been met, but none that have proved too difficult to solve. That part-time courses appeal to the class of pupils who, under the usual conditions, drop out of school, has been proved by the fact that a great number of those who had left school came back to the part-time courses.

The American Locomotive Company of Pittsburgh has agreed to a plan that will give to the high school entrants not only a high-school education, but also a definite objective of work. The course is planned on a five-year basis. The first year will be devoted entirely to school work. During the second, third, and fourth years, the alternate-week program will be carried on. The fifth year will be given entirely to work in the shop. Upon satisfactory completion of the work, a diploma will be granted by the Board of Education, and a certificate by the industrial plant.

A Research Bureau for Retail Training has been established through the co-operation of the Carnegie Institute of Technology, the Board of Public Education and some progressive department stores. Many who believe that retail commercial work is an inferior occupation have offered strong opposition, but the upholders of the plan, backed by able scientific men, have succeeded in establishing training school work, and they call attention to the fact that in one department store alone there are more than 100 persons receiving salaries of $4,000 or more. In this work also the alternate-week plan is adopted. The evidence thus far seems to point to the conclusion that with properly regulated work, almost as much can be accomplished both in school and in employment as was formerly accomplished by giving the time exclusively to either activity.

The paper will repay careful study in detail on the part of any one interested in this promising new line, efficiency-engineering. — G. E. Partridge.

COLLEGE EDUCATION FOR INDUSTRIAL WORKERS. *P. R. Kolbe.* School and Society, September 13, 1919, 10, No. 246, 324–325. — A brief account of the work of the Municipal University of Akron in providing college education on a part-time basis for the young men and women of the city, a great number of whom are employed in the rubber factories. Several plans are in operation. Some of the factories have a three-shift program, one shift being in service from midafternoon to midnight, and in this way leave the morning hours free for college work. There is also a night school. By means of a co-operative plan, students in engineering courses in the college alternate between work and college, in two-week periods. — G. E. Partridge.

AGRICULTURAL EDUCATION. National Society for Vocational Education, Bulletin No. 31, pp. 30. — Purpose and methods of supervision in a state system of agricultural education; discussion of important problems of agricultural education; present and future relations of vocational agricultural education and agricultural extension. — G. E. Partridge.

RECENT DEVELOPMENTS IN INDUSTRIAL TRAINING. *D. Rosenstein.* School and Society, August 9, 1919, 10, No. 241, 155–163. — This article is a brief account of the work of the training school of the Emergency Fleet Corporation at Newport News, and of the United States Training Service of the Department of Labor, which the author says is a projection into peace times of the government's interest in war labor activities, and is a recognition of the present great need of industrial training. The function of the training service is to encourage the institution of special training departments in the industrial establishments of the country, and to give practical assistance in their organization. The country has been mapped out into twelve districts, to each of which a field supervisor of training is assigned. The work represents also a propaganda to advertise among manufacturers the practical and paying features of organized training. This training work is intended to be immediately practical, and to

form a necessary link in the process that begins with the employment department. The cost of making raw labor available for industrial purposes is as much a real cost as the cost of converting raw materials into the finished products.

In the opinion of the writer of the paper, this new industrial training opens up a broad educational field, and is closely related to the social aspect of vocational training. "It will really place an instrument in the hands of the worker by means of which he can learn to control his industrial destiny, and gradually shape the industrial age in which he finds himself so that it will yield him a greater measure of spiritual satisfaction, freedom, happiness and the leisure to pursue higher ends." — G. E. Partridge.

Theodore Roosevelt and Industrial Education. *E. B. Thomas.* Manual Training Magazine, October, 1919, 21, No. 2, 39–40. — The writer brings together some of the late President's arguments for a much wider industrial training than we have at present, with a view to furnishing more practical training and preventing the decline, in this country, of the ideal of hard work. "My plea is for a tremendous expansion of the vocational, industrial and technical side of education. . . . The printer, the electrical worker, the house painter, the foundry man should be trained just as carefully as the stenographer or the drug clerk." — G. E. Partridge.

Proceedings of the Twenty-seventh Annual Meeting of the American Psychological Association, Baltimore, December 27 and 28, 1918. Report of the Secretary, *H. S. Langfeld.* The Psychological Bulletin, February, 1919, 16, No. 2, 33–61. — Several of the papers here presented in abstract contain items of interest to the practical psychologist. Occupational Therapy is treated by B. T. Baldwin, and the Relation of Intelligence to Occupation as Indicated by Army Data, by J. W. Bridges. R. Dodge emphasizes the result of the war in bringing to the front a great problem of mental engineering. There are brief reports of papers on the results and values of psychological examining in the United States Army, problems of re-education, army trade tests and their practical application, methods of testing intelligence, the selection and training of telegraphers, examination of emotional fitness for warfare. These papers seem to indicate that the predominant interest of psychologists at the present time is in the further development of the problems and methods of individual psychology that have been brought to the front by the war. — G. E. Partridge.

Lessons of the War. National Society for Vocational Education, Bulletin No. 28, June, 1919.

This bulletin of the National Society for Vocational Education contains the following interesting papers: Rehabilitation of Wounded Soldiers, A. D. Dean; Re-Education of Wounded Soldiers, J. A. C. Chandler; Lessons from the Experience of Training Shipyard Workers, E. E. MacNary; Use of Vocational and Technical Schools for Training Army Mechanicians, C. R. Dooley; The War Work of the Industrial and Trade Schools, J. C. Wright. Generalizing the contents of these papers, one may infer that the war has taught, first of all, the necessity and the economy of applying, to a far greater degree than has hitherto been done, principles of scientific analysis and clear thinking to the problems of industry. The acute problem of replacement that arises when a man is totally disabled so far as concerns his previous occupation (the Federal Board for Vocational Educatiou estimates that there are 50,000 such cases) will yield, in its successful handling, results of wide general application to the problems of vocational training and adjustment.

Close study of the factors of efficiency, under stress of war conditions, has demonstrated the great value of definite and intensive training in the production of skill in labor. Only about half the required number of men skilled in the special army occupations were available through the draft. The work of the Committee on Education and Special Training in producing the experience required was an experiment in industrial education on a large scale, and in the opinion of the Director of the Vocational Section, the special training was highly successful, and has had a marked general educational effect.

The experiences of the war indicate the need of (1) more evening schools, especially those offering short intensive courses to supplement the daily employment of the worker, and (2) modifications in both day and evening courses in trade schools and elsewhere, to increase their immediate value to the individual, and at the same time to serve not only the needs of industry, but also those of a modern army. — G. E. Partridge.

Giving Soldiers the Best Chance. *P. A. Best.* System, July, 1919, 36, No. 1, 80. — Mr. Best, director and general manager, Selfridge and Company, Ltd., London, outlines in a clear and practical manner the policy of his company. This company had 1,079 of its employees in service and has followed consistently the common policy of receiving back into its employ those who left to take part in the war. It has gone farther, however, in attempting to place returning soldiers, not in the positions which they occupied prior to the war, but in positions for which they would be fitted had not the war interrupted their connection with the firm. This policy has not been followed blindly, but has involved constant contact with employees during their absence and the keeping of individual records of all absentees. Nor is the returned employee asked to undertake work for which he may not have had necessary experience. Special courses are provided for those requiring added resources of information and training. This system has been carried to the extent of offering correspondence courses to employees prior to their discharge from the army.

The writer finds that this plan has been highly successful. He does not feel that on the whole the war has had a harmful effect upon the majority of

the men who have returned to his company. On the contrary, he states that a new feeling of self-confidence and initiative has been established. He places emphasis upon the threefold human service which is the new function of the manager of a business enterprise: service to the worker, service to the customer, and service to the state. In speaking of service to the employee he mentions proper working conditions, adequate opportunity for advancement, and a sufficient and just wage. — C. H. Paull.

Investigation into the Cases of One Hundred Boys Who Left School to Go to Work. *D. I. Cohen.* Educational Foundations, February, 1919, 30, 239–243. — G. E. Partridge.

Occupational Diseases in Pennsylvania. *A. Hamilton.* U. S. Bur. Labor Statis., Month. Labor Rev., July, 1919, 9, No. 1, 170–180. — Among the important causes of occupational diseases in Pennsylvania, the author mentions poisoning from lead, carbon monoxide, brass, mercury, arsenic, various gases, and coal-tar products. Certain occupations, such as those found in the steel and textile industries, and in mining, are important sources of occupational diseases. Special consideration is also given to anthrax. Each source of occupational disease is discussed briefly from the standpoint of occurrence in industry, source of danger, and character and seriousness of risk to workers. A careful distinction is made between the immediate and the deferred injuries to health received in various occupations. In the case of lead poisoning, for instance, the writer points out that the relation between lead colic and employment in an industry using white lead extensively is unmistakable. On the other hand, a deferred result, such as hardening of the arteries which might arise from another cause and which might not appear for several years, and then only gradually, would be difficult to diagnose absolutely as an occupational disease. For this reason, it is concluded that provision for compensation for occupational diseases will never completely solve the problem of alleviating the distress arising from such disabilities. — C. H. Paull.

Health of Ohio Coal Miners. Abstract of a report by *E. R. Hayhurst.* Ohio Pub. Health Jour., May, 1919, 10, No. 5, 199–203. — In the Ohio mines diagnostic facilities are so inadequate that recourse is usually had to large cities. Availability of hospitals varies. When the hospital is in the mining community itself, much more extensive use is made of it by miners and their families than when it is at a distance.

The physician's fees may be paid either by benefit associations and lodges, or by the individual, in case he is not thus insured. In the former case the filling of certificates proves an insufferable nuisance to the physician. General average collections in normal times are about 75 per cent. Quackery, the practice of charlatans, prescriptions by druggists, self-diagnosis, etc., are practised extensively, and may be considered due, in most instances, to a lack of funds.

A general summary is appended to this article — the conclusion of a series — giving the status of the operatives in the Ohio coal mines as set forth in this and in the preceding articles. — L. A. Shaw.

Publications of the Bureau of Mines. List No. 671700–18–1. — A general list of technical health and sanitation bulletins issued by the Bureau of Mines, brought up to August, 1918. — H. W. Haggard.

Educating the Coal Miner in Subjects Pertaining to Mining. *A. C. Callen.* Vocational Summary, January, 1919, 1, 15–17. — G. E. Partridge.

New Observations on the Life of the Bedbug (Cimex Lectularius, L.). *Albrecht Hase.* Centralbl. f. Bakteriol., Ite Abt., Orig., 1919, 83, No. 22. — A study of the life habits of the bedbug in relation to its powers of reproduction and propagation under various conditions. Circumstances such as found during the war in emergency lodging quarters, barracks, camps and ships have furnished ideal conditions for the rapid spread of infestation by bedbugs. Optima are warmth, 30° C., and abundance of food. Prompt and energetic action is necessary to prevent rapid further spread of infestation. — B. Cohen.

Alcohol and Crime. *M. J. Rowe.* The Journal of Delinquency, July, 1919, 4, No. 4, 135–151. — The author thinks it is justifiable to conclude that 60 per cent. of all crimes of violence, 50 per cent. of the crimes of sex, and possibly 10 per cent. or 15 per cent. of the premeditated crimes of acquisitiveness are directly due to alcohol. — C. E. Partridge.

Treatment of Drug Addiction. *A. D. Greenfield.* U. S. Pub. Health Ser., Pub. Health Rep., July 18, 1919, 34, No. 29, 1577–1579. — Advice to the medical profession, derived from recent decisions of the U. S. Supreme Court which define what does and what does not constitute legitimate professional practice in the administration of narcotic drugs. — L. A. Shaw.

New Rules and Regulations of the State Department of Narcotic Drug Control. N. Y. City, Department of Health, Weekly Bull., July 5, 1919. New Series, 8, No. 27, 209–211. — Nine rules and regulations for the administration of the Department of Narcotic Drug Control of the state of New York. — L. A. Shaw.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

CIRCULATION

The Bicarbonate Concentration of the Blood Plasma in Cases of Irritable Heart. *F. N. Wilson, S. A. Levine*, and *A. B. Edgar*. Heart, July 22, 1919, 7, No. 2, 62. — The experiments were performed on fourteen patients with a severe grade of disordered action of the heart. The Van Slyke-Cullen method of determination of the bicarbonate concentration of the plasma was used. There was no definite reduction in the alkaline reserve of the blood in these cases. The authors conclude, therefore, that the breathlessness was not due to acidosis. — C. C. Lund.

PULMONARY SYSTEM

Lungs and Breathing in Wind-Instrument Players: A Contribution to the Question of the Development of Emphysema. *N. Jagić* and *J. Lipiner*. Wien. klin. Wchnschr., June 26, 1919, 32, No. 26, 683–687. — The authors selected forty-six musicians who had played several hours daily for many years. One had played for ten years and two had played for more than fifty years; the rest fell between these extremes. In their selection, the authors excluded those with heart or lung lesions which they could judge *a priori* not to have been due to their occupation, and also those who were not of good social and economic position. The study included a careful history of each man, a physical examination of the thorax and lungs, X-ray study of the lungs and diaphragm in ordinary and deepened breathing, and radiologic observation of breathing (movement of the diaphragm) during playing. In none of the persons examined was there demonstrable a marked or even increased emphysema. The conclusion is drawn, therefore, that the playing of wind instruments cannot be considered of etiologic significance in the development of emphysema. — B. Cohen.

CENTRAL NERVOUS SYSTEM

The Achievement of Mental Defectives in Standardized Educational Tests. *J. E. W. Wallin*. School and Society, August 30, 1919, 10, No. 244, 250–256. — A practical study of the mental ability of defectives, their educability, and their status. — G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Industrial Hygiene Studies. *Wolfgang Weichardt* and *Herman Apitzsch*. Ztschr. f. Hyg. u. Infektionskrankh., May 15, 1919, 88, No. 2, 105. — II. *Injuries from Oils in Industrial Pursuits.* — A brief discussion of unsatisfactory commercial cleansing powders for removing or neutralizing irritating properties from low-grade grinding and cutting oils used as war substitutes in Germany.

III. *Prevention of Percutaneous Anilin Poisoning.* — This paper describes animal experiments on mice with substances to prevent or minimize skin injury from anilin and skin absorption of it. The conclusions reached are as follows:

1. Percutaneous anilin poisoning can be favorably influenced by aldehydes, such as formaldehyde and glucose, due to the formation of non-toxic Schiff's bases.

2. Poisoning can be prevented entirely by use of aldehydes previous to and shortly following the exposure. Later use will distinctly lessen toxic action.

3. The authors recommend the practical employment, in affected industries, of a dilute formalin wash or a formaldehyde soap after exposure. — H. F. Smyth.

Normal Zinc, Arsenic and Copper Content of Human Body. *Van Itallie*. Nederl. Tijdschr. v. Geneesk., May 10, 1919, 63, First Half, No. 19, 1709. — Apropos of a review of an article of Delézenne's, van Itallie publishes a paragraph calling attention to the fact that he and van Eck wrote an article in 1912 (in *Verslag. en Mededeelingen van de afdeeling Wis en Natuurkunde der Koninklijke Academie van Wetenschappen*, Vol. 21, p. 759, and in the *Pharmaceutisch Weekblad*, Vol. 49, p. 1157), the subject being the normal zinc, arsenic, and copper content of the human body. They found from 17.7 to 86.6 mg. per kilo of liver in twenty-four human subjects and 81.1 mg. per kilo of liver in a fasting calf. — N. C. Foot.

Dangers of Welding with the Oxyacetylene Torch. *J. P. L. Hulst*. Nederl. Tijdschr. v. Geneesk., May 31, 1919, 63, First Half, No. 22, 1933–1941. — This is a case report with an autopsy protocol. The patient was welding with an oxyacetylene torch in a boiler, the man-hole of which was turned upward. His light was obtained from the torch, no other artificial light being used. He got along all right until the boiler was turned on its side, with the man-hole pointing sideways, when he complained of lack of air and was given a compressed-air line to improve ventilation. After a short time he came out of the boiler, complaining of oppression, chilliness and coughing. He went home, called in a physician and died in twenty-four hours. The autopsy showed marked bronchitis, extensive localized inflammation of both lungs, with edema and some fibrin. There was necrosis of the epithelium of the convoluted tubules of the kidneys, slight fatty degeneration there and in the heart-muscle. A few petechiae of pericardium and pleurae, many scat-

tered perivascular hemorrhages of cerebrum, cerebellum and pons, with increased intracranial pressure. There was a good deal of fluid blood in the auricles, with small clots, all post-mortem.

The writer then discusses the cause of death. An analysis of the acetylene gas used showed phosphine, hydrogen disulphide, nitric acid and free chlorine, all to be absent; so that he rules out these possible causes. Blood analysis was quite negative. The death was obviously caused by slow asphyxia due to a poisonous gas, and the author points out the probability of its being carbon monoxide. Pure acetyelne gas, he says, could cause death and he cites cases from the literature. He states that the pathology of this poison is practically unknown, and concludes by pointing out that carbon monoxide and carbon dioxide are more probably the causative agents in this case, the former especially. He emphasizes the necessity for prompt blood analysis in such cases, as he believes that carbon monoxide could disappear from the blood in a very short time post-mortem. — N. C. Foot.

Two Cases of Poisoning by an Explosive. *F. Reach.* Wien. klin. Wchnschr., February 27, 1919, 32, No. 9, 225–226. — Two soldiers mistook some Italian explosive, *cheddit*, for corn meal, made a soup of it and consumed respectively one and two plates of it. This explosive is a mixture of T.N.T. and a chlorate. Fatal termination did not ensue until three days later. The dirty brown color of the blood was a striking feature at autopsy. — B. Cohen.

Trinitrotoluene Poisoning. *T. M. Legge.* Ann. Rep. Chief. Inspect. Factories and Workshops, Great Britain, for 1917, pp. 21–24. — The conditions imposed by the war were maximum output, very great pressure, continuous employment day and night, and replacement of men by women in industry. There was no appreciation of the insidiously poisonous nature of T.N.T. and of the right measures of prevention by cleanliness of work, by prevention of dust and contamination of the skin with the substance. The first fatality attributed to T.N.T. occurred in February, 1915. The striking feature was the jaundice which closely resembled that observed in poisoning from tetrachlorethane. Two more fatalities were reported and the need became apparent for information as to the prevalence of T.N.T. poisoning. Consequently, an order was issued making *toxic jaundice* a notifiable disease. The reason for making toxic jaundice notifiable, and not T.N.T. poisoning, was the belief that publication of statistics of notifications of T.N.T. poisoning would be unreliable, as they would simply refer to a number of T. N. T. workers seeking medical treatment for any complaint. But figures published of incidence of toxic jaundice would furnish a real indication of serious illness due to the compound. The number of cases reported for each quarter of 1916 and 1917 were: 6^{4}, 16^{5}, 73^{21}, 86^{22}, and 83^{12}, 56^{20}, 21^{8}, 29^{4}. (Upper figures indicate fatalities and are included in the corresponding lower ones.) The figures arranged as above bring out features that annual totals would obscure. In 1916 the number of males attacked was 70, with 21 deaths, and of females 111, with 31 deaths; and in 1917 there were 45 male cases with 2 deaths, and 144 females with 42 deaths. High mortality for persons under eighteen in 1916 led to restriction of employment of persons under that age. Figures cannot be given as to the numbers employed, but those coming in contact with the T.N.T. are estimated at more than 50,000. At this figure, the incidence of toxic jaundice was about 3.7 per 1,000 and the mortality about 1.0 per 1,000.

For every case of toxic jaundice, it is believed there were at least thirty cases showing minor symptoms, like pallor with cyanosis, depression or gastric derangement. None of these proved fatal, and, as a rule, they quickly recovered under treatment and returned to work. It is interesting to note that in one National Filling Factory the sickness figures fell from 11 per cent. in August, 1916, to 1 per cent. in January, 1918. Incidence has been comparatively small where T.N.T. is manufactured, as the nature of the processes does not involve the same contact with the material as does the use in filling.

The great fact brought out by close study of the precise occupation of those with toxic jaundice is the importance of skin absorption, which is difficult to overcome. It is easy to suggest the wearing of gloves, and gloves were provided and worn by the million. They never adequately protected the skin, and eventually were regarded more as a source of danger than a safeguard, and their use was given up. It was the same also with the continuous wearing of respirators, which has proved an impracticable remedy. Fortunately, exhaust ventilation, locally applied, has proved more satisfactory. — Barnett Cohen.

Doping in Aircraft Works. *W. S. Smith.* Ann. Rep. Chief. Inspect. Factories and Workshops, Great Britain, for 1917, pp. 18–20. — Manufacture of dope containing tetrachlorethane ceased in September, 1916. During the period such dopes were used, seventy cases of toxic jaundice, including twelve deaths, came to the knowledge of the Factory Department, in addition to numerous cases of suspension and transference to other work for illness due to the same cause. The new dopes are said to be more nauseating in smell and taste than the old. The acetone substitutes (ketonic derivatives) used in the new dopes seem more pungent in odor than the ordinary acetone previously used. The substitutes appear to be impure mixtures of methyl ketone, methyl-ethyl ketone and higher homologues. Amyl acetate is also used in the pigmented varnishes and colors, and benzol is a constituent of all dopes and aeroplane varnishes.

Efficient ventilation is stressed as the most effective means of keeping down the incidence of poisoning by these fumes. It has been found that if twenty-seven or more changes of air per hour can be maintained in the doping rooms, the danger from poisoning is minimized. Efficiency in design of the ventilation system is discussed and a general plan of such a system is suggested.

Spraying of the dope has been attempted in some factories. This procedure gives off more fumes, and the atmosphere in the vicinity soon becomes misty. In such cases a high standard of ventilation is still more necessary. It is probable that localized ventilation will be introduced for the spraying processes.

Physicians examined a number of workers in three dope rooms in the London area and concluded that: (1) A mild degree of anemia exists among aeroplane dope workers, and (2) the anemia is of no practical importance, except as an indication that any relaxation of the regulations might be accompanied by cases of serious illness. — Barnett Cohen.

DUST HAZARDS AND THEIR EFFECTS

Fourth Report of the Committee for the Investigation of Atmospheric Pollution. Meteorological Office (England). Report on Observations, 1917–1918. Supplement to The Lancet, June 14, 1919, 196, No. 4998, 1–23. — A report dealing with the amount of deposit of solid material from the air in England. A detailed description of the apparatus for the observation and recording of air pollution is given. — J. C. Aub.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Tuberculosis: Its Predisposing Causes. *F. C. Smith.* Michigan Department of Health, Public Health, August, 1919, New Series 6, No. 8, 356–359. — At an early age practically all people become slightly infected with the tubercle bacillus. Safety depends, therefore, on the maintenance of a high degree of resistance. This may be accomplished by the daily observance of general hygienic principles, toward which end recommendations are made in this article. — L. A. Shaw.

Some Activities of the Michigan Anti-Tuberculosis Association during 1919. *E. R. Van der Slice.* Michigan Department of Health, Public Health, August, 1919, New Series 6, No. 8, 343–349. — Activities of the Michigan Anti-Tuberculosis Association under the stimulus of war demands. — L. A. Shaw.

Social Hygiene and the War. A reprint from Social Hygiene, April, 1919, 5, No. 2. — G. E. Partridge.

The Massachusetts Plan. *A. N. Thomson.* Social Hygiene, July, 1919, 5, No. 3, 317–335. — A special subdivision for fighting venereal diseases was organized within the Division of Communicable Disease of the State Department of Health. The plan of organization provided for:

1. Continuance of free diagnostic facilities.
2. Establishment of free treatment facilities.
3. Reporting of venereal diseases.
4. Elimination of quacks and charlatans.
5. Prevention of treatment by drug clerks.
6. Examination and treatment of prisoners.

The state of Massachusetts received $36,000 under the Chamberlain-Kahn Bill. In vice repression, education, records and treatment of venereal diseases, the government program was followed. From the start it was felt that the primary work would have to be conducted along two main lines — education and treatment. Much stress was laid upon the publicity campaign carried on through the newspapers and film exhibits, by means of which the fight against venereal diseases was brought straight into the open.

In the manufacturing plants the reaction to venereal disease propaganda was invariably satisfactory. In this respect the following agencies were instrumental in the educational campaign: the Section on Men's Work of the Social Hygiene Division, the Section on Women's Work of the same Division, the War Department Commission on Training Camp Activities, the Massachusetts Health Committee, the Boston City Club, the Boston Press Club, the State Committee of Public Safety, etc.

In the matter of treatment, the reporting law was found very effective in detecting new cases and in controlling cases already under treatment. There are at present in operation seventeen clinics in the state. Safeguards are thus placed about the non-infected, and the infected are rendered non-infectious. — L. A. Shaw.

Annual Report, State of Alabama, Bureau of Venereal Disease Control. January 1–December 31, 1918, 164–167. — The Bureau of Venereal Disease Control of Alabama is supported by the $23,247.15 which Alabama receives under the Chamberlain-Kahn Fund. The activities of the department are confined to the following lines: (1) Education; (2) Elimination; and (3) Co-operation. A remarkable change of attitude toward this class of diseases is noted, and great results are looked for. — L. A. Shaw.

Venereal Diseases. U. S. Public Health Ser., Public Health Rep., July 25, 1919, 34, No. 30, 1623. The Supreme Court of Nebraska, in a recent case, upholds the right of local health authorities to quarantine a person infected with a venereal disease. — L. A. Shaw.

Some Changes in the Plans of Campaign for Control of Venereal Diseases. New Jersey State Department of Health, Public Health News,

August, 1919, 4, No. 9, 246–248. — When the campaign for control of venereal diseases was inaugurated in New Jersey, it was thought necessary to develop a large central organization to carry on the work. It is now deemed advisable to look to each community to assume control of its own venereal disease problems, and to co-operate with the State Department of Health. — L. A. Shaw.

A Development in the Venereal Disease Crusade. *M. R. Lakeman.* Commonhealth, Bull. Mass. State Department of Health, May–June, 1919, 6, No. 3, 116–117. — Clinical facilities developed under the state Department of Health of Massachusetts for the treatment of venereal diseases are considered adequate to render non-infectious all cases which come to hand. There are many cases, however, which will not of their own volition seek treatment. Such cases must be sought out by the social worker and the so-called special investigator. — L. A. Shaw.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Training the Foreman. *J. E. Calder.* Safety, July–August, 1919, 7, No. 6, 135–138. — The efforts of safeguarding industry are only partly engaged with rails, guards, goggles and dust fans. They are chiefly concerned with ignorance, obstinacy, sullenness, and smartness. A well-trained foreman can do much to encourage the safety habit in his workers. — G. M. Fair.

From the Foreman's Point of View. *W. A. Clark.* Safety, July–August, 1919, 7, No. 6, 139–142. — A short safety talk given to employees of the Duluth, Missable and Northern Railway Company by their general car foreman. — G. M. Fair.

Overwork the Cause of Accidents. Quarterly Bull., Louisiana State Board of Health, June, 1919, 10, No. 2, 81. — Conclusions arrived at by F. S. Lee, Consulting Physiologist, U. S. Public Health Service, relative to the relationship between accidents and overwork. — L. A. Shaw.

No-Accident Campaign on U. S. Railroads. Labour Gazette, August, 1919, 19, No. 8, 866. — Statistics of the No-Accident Week Campaign of June 22 to 28, held by the U. S. Railroad Administration through its Safety Section. — L. A. Shaw.

Libraries in Safety Work. Am. Industries, August, 1919, 20, No. 1, 23. — A brief statement of ways in which libraries can assist in the safety movement. — C. H. Paull.

Power Drives for Sewing Machines. *Chester C. Rausch.* Safety, June, 1919, 7, No. 5, 121–127. — A discussion of power-driven sewing machines and the problems of safety engineering connected with the protection of the operators. — G. M. Fair.

Accident Reduction at the New York Navy Yard. Safety, June, 1919, 7, No. 5, 127–129. — A standard accident register was adopted for use in federal arsenals and navy yards. The methods of keeping the statistics accumulated by the New York Navy Yard are discussed in this article. Free use was made of graphical representations for the purpose of safety education. — G. M. Fair.

Reducing the Hazards of Peace. *Fred R. Johnson.* Survey, July 12, 1919, 42, No. 15, 566–567. — Mr. Johnson gives an account of the recent safety campaign to reduce street accidents in Detroit. The article should be suggestive of the possibility of enlarging the scope of such a campaign to include all classes of preventable accidents. Through publicity Detroit showed a remarkable decrease in fatalities during the campaign month. — C. H. Paull.

Recent Progress in the Manufacture of Glasses for Protecting the Eye from Injurious Radiations. *W. W. Coblentz.* Jour. Franklin Inst., August, 1919, 188, No. 2, 255–261. — The subject of eye protection against injurious radiations has become national in importance and manufacturers of eye protective glasses are meeting the most stringent requirements. Dr. Coblentz gives the transmission curves of a variety of glasses and discusses the characteristics of such glasses as singly or in combination afford protection from injurious radiations. — G. M. Fair.

On Several Cases of Evaluation of Incapacity for Work After Ocular Accidents. *A. Demault.* Arch. d'opht., January–February, 1919, 36, No. 7, 418–437. — "Under French law, total incapacity for work corresponds, not to 100 per cent. partial incapacity, but to 133 per cent. incapacity. From this fact there results a difficulty in appraising almost total incapacity.

"The usual notation of visual acuity, by the proportion between the distance at which an optotype is seen by the patient and by a normal eye, is much preferable to those which have been proposed to replace it. But its figure does not express the functional value of the eye. It gives too much importance to inferior visual acuities.

"To have equal gradations of the functional value of the eye, perhaps the best method is to arrange the visual acuities in geometrical progression. Nevertheless, this principle is not strictly accurate, even from the physiological point of view. From the medico-legal point of view, it cannot be applied except within arbitrary limits.

"The enucleation of one eye being estimated usually at 33 per cent. disability, unilateral loss of sight with retention of an apparently normal ball should be estimated at 30 per cent.

"Practically one can consider a visual acuity of one hundredth as being equivalent to blindness, and that of one-tenth as representing about a third of normal vision." — T. J. Putnam.

Army Gas Masks Unsuited for Use in Industries. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 240–243. — Owing to the many misconceptions regarding the use of the army gas mask in the industries, the Bureau of Mines is issuing a brief statement of the industrial use and limitations of dust respirators, gas masks, and oxygen-breathing apparatus. — L. A. Shaw.

INDUSTRIAL SURGERY

Hyperpyrexial Heatstroke. *K. C. Hearne.* Brit. Med. Jour., April 26, 1919, No. 3043, 516. — The author's observations in Mesopotamia lead him to believe that heatstroke is entirely due to suppression of sweating, which may be present from one to forty-eight hours before the attack. With sweating suppressed, the bodily temperature tends to adjust itself, in accordance with physical laws, to the temperature of the atmosphere, which may be 115° to 120° at the time; or even to rise higher, as a rise in bodily temperature produces increased respiration and nitrogenous exchanges, resulting in a further increase of endogenous bodily heat. The processes continue until, when a temperature of about 108° or more is reached, sudden unconsciousness, delirium, and convulsions appear — the result of the physical action of the heated blood upon the specialized brain cells. The author has repeatedly observed the pre-existence of suppression — in one case for as long as eighteen hours before the attack — while in other instances he has obtained a history of it. It is probably due to the exhaustion of the sweat mechanism. Diaphoretics have no effect.

The author recommends frequent inspection — hourly, under extreme conditions — of those exposed to heat. Anyone who is discovered to have a temperature of 103° with complete suppression is stripped and covered with a wet sheet. An electric fan may be used if needed. The sheet may be raised on cradles and kept wet by an automatic spray. In the ward under his charge the author reduced the number of cases of heatstroke by these means, from nine in a week to two in two months. — T. J. Putnam.

Picric Acid Treatment of Burns. *V. G. Thorpe.* Jour. Roy. Nav. Med. Serv., April, 1919, 5, No. 2. — Picric acid dressings dry quickly and become adherent. They should be left on and, as long as they are kept dry, need not be removed. The method of procedure in applying a picric acid dressing is as follows:

1. Use sterile gloves.
2. Cut away the blisters with scissors.
3. Wash the burned surface with 1–40 carbolic lotion.
4. Dip soft white wool in picric acid solution, drain off the superfluous fluid, and apply the wool sopping wet to the raw surface of the burn, pressing close to exclude air bubbles. Do not remove the dressing until the wool becomes loose with the process of healing. In the event of suppuration, remove the wool and, after careful washing, repeat the above process.

The writer has obtained particularly supple scars from the above treatment. — W. Herman.

The Treatment of Burns. *A. M. Fauntleroy* and *A. W. Hoagland.* Ann. Surg., June, 1919, 69, No. 6, 589–595. — This article is best summarized by the authors' own conclusions:

"Our experience demonstrates to us the value of the following. The need for the quick institution of immediate general supportive measures in patients suffering from extensive burns. The value of fluids in large quantities by mouth and bowel, even before the so-called toxemia or acidosis symptoms commence to appear. Later, during the absorption period, from large infected areas, the addition of the continuous use of small doses of morphine sulphate seemed to us to be of distinct advantage. It certainly serves to keep the patient quiet and thereby reserves his energy for later use. Too much stress cannot be laid on the value of these general measures, used as a prophylactic procedure, immediately following injury, before the advent of those well-known toxic symptoms, which are sure to follow in one extensively burned. We deem them far more important than any value obtained by laying too much stress upon the burned area during this initial period. It was again proved to us: That patients extensively burned quickly go into a severe shock the first twelve hours. That reaction from this period may be followed by an equally fatal period on about the fourth or fifth day. That recovery from this period is later followed about the fourth or fifth week by a period in which the element of exhaustion is a very important consideration.

"Our local procedure demonstrated the following: Initial antiseptic cleansing, alcohol, boric acid solution, salt solution, Dakin's, Wright's solution all proving equally efficacious. Gentle dressing manipulation during this period with traumatism reduced to a minimum. As soon as possible the application of a simple protectant, paraffin, ointment, gutta percha, or rubber strips.

"Our local measures again proved to us: That no one procedure, wet or dry dressing, wax, ointment, or that no one solution proves equally valuable for all cases. That the individual question of how the particular area reacts to the solution used is an important one. That there is a distinct difference between the mild stimulation and healing effect of bland protectants such as wax, liquid petrolatum, and vaseline. That the so-called "switching time" in the application of these various dressings is a distinctly important one. That some patients cannot tolerate open-air exposure. That the absolute non-interference and non-removal of semi-adherent tags of skin is usually the best procedure." — H. A. Bulger.

Baths for the Emergency Treatment of Acid Burns. Safety, July–August, 1919, 7, No. 6, 154–

155. — The E. I. du Pont de Nemours & Company plants in which strong acids or caustics are handled are equipped with shower baths of special design for use in case of accidents. The article gives a description of the arrangement and construction of the showers. — G. M. Fair.

Remarkable Case of "Employee No. 1653." Bull. N. Y. State Ind. Com., July, 1919, 4, No. 10, 182–186. — This article gives an account of the treatment of an employee of the Railway and Light Company of Rochester, New York. This employee was severely burned and scalded by ashes and steam in the ash pit of one of the company's power plants. His injuries were so serious that, taking into account the fact that he was 60 years of age, it was feared he would not survive the shock. The burns were dressed, however, and carefully covered with wax. This treatment was repeated consistently, and the patient recovered so rapidly that he was able to return to work at the end of sixty-three days. The attendant physician expressed the greatest satisfaction at the result of the wax treatment. The account of this case is made more graphic by a number of photographs showing the severity of the burns and the completeness of the healing. — C. H. Paull.

FATIGUE AND OCCUPATIONAL NEUROSES

Fatigue Elimination. *Mrs. F. B. Gilbreth.* Industrial Reconstruction Problems, Report of the Proceedings of the National Conference of the Society of Industrial Engineers, March 18, 19, 20 and 21, 1919, 183–186. — The necessity of maximum industrial efficiency during the war has stimulated popular interest in fatigue elimination. Other contributing causes of the movement to reduce fatigue are: (1) The introduction of a large body of women into industry; (2) special attention demanded by the returned disabled soldiers; (3) increase of interest in scientific management and efficiency methods. The elimination of fatigue is a problem not only for individual plants, but for entire communities and industries.

The program consists of two parts — first, eliminating unnecessary fatigue from the operation and second, providing for recuperation from necessary fatigue involved therein. Present procedure and possible ultimate improvements must be carefully considered. Rest periods should be determined upon with reference to the nature of the work. — L. A. Shaw.

Muscular Tonus in Relation to Fatigue. Abstract of a paper by *A. H. Ryan, S. Jordan* and *A. B. Yates.* U. S. Public Health Ser., Public Health Rep., July 25, 1919, 34, No. 30, 1622–1623. — Muscular tonus in relation to fatigue was investigated in the hope of finding further methods for the detection of the more pronounced degrees of fatigue resulting from the day's work, and for the purpose of studying cumulative fatigue. An account is given of the apparatus used and of the results obtained. — L. A. Shaw.

NUTRITION AND METABOLISM

Metabolism of Female Munition Workers. *M. Greenwood, C. Hodson,* and *H. E. Tebb.* Brit. Med. Jour., May 31, 1919, No. 3048, 682. — "The rate of metabolism was determined by the method of direct calorimetry. Making the due allowance for metabolic needs during non-working hours recommended by the Royal Society Food (War) Committee, the workers were found to fall into four classes, for each of which the daily net requirements per average woman were 2530 calories, 2810 calories, 3200 calories, 3425 calories. The results were concordant with the inferences drawn from a study of food consumption in a large explosive supply factory during the war." — T. J. Putnam.

WOMEN AND CHILDREN IN INDUSTRY

Women's Work and Welfare. N. Y. City, Department of Health, Weekly Bull., July 5, 1919, New Series, 8, No. 27, 211–212. — A report recently published in England entitled, *Women in Industry,* concerns the experience of that country with the enormous amount of labor done by women during the war. Women, except where great physical strength is called for, are the equals of men. While it was found that extensive employment tended to lower birth-rate and increase infant mortality, it was concluded that these evil effects were due largely to ignorance, poverty, and bad general sanitary surroundings — conditions which could be made obsolete by proper regulations and laws. — L. A. Shaw.

War-Time Participation of Women in Industry. *C. B. Lord.* National Society for Vocational Education, Bulletin No. 28, June, 1919, 77–82. — The writer offers conclusions based upon the experiences of the Wagner Electric Manufacturing Company of St. Louis in employing women. There are several distinct types of women workers. Suc-

cessful work depends considerably upon the selection of the right type and also upon the temperament of the foreman. It is not necessary to segregate women in the shops. Equal pay for equal work must be the rule; in other words, the product produced by women should cost the same as that produced by men. Costs of nurses and welfare workers must be included.

A vital factor in the proper management in the shop is the uniform. There are many questions of detail that are highly important. Sanitary conditions must be carefully studied, because it is the neglected 5 per cent. of the conditions that may be the most important. Temperament of women workers as a class must be taken into account in all regulations, and much attention must be given to cheerfulness of surroundings. All machines used by women in the Wagner shops are painted with white enamel. — G. E. Partridge.

Women in Industry. *S. D. Hubbard.* N. Y. City, Department of Health, Month. Bull., May, 1919, 9, No. 5, 125–126. — If women are to fulfill their dual position — worker and mother — which society imposes upon the laborers of to-day, a campaign of education is necessary in order that both employer and female employee may understand the conditions affecting the health of women. Suggestions which will enable employers to safeguard the health of women workers are herein given, together with a list of special topics to be presented as educational propaganda. — L. A. Shaw.

Initial Training and Upgrading of Women Workers in Factory Industries. *Anna L. Burdick.* National Society for Vocational Education, Bulletin No. 30, June, 1919, 54–61. — The United States census of 1910 reports about 8,000,000 women engaged in gainful occupations. The number of men in the same class was about 30,000,000. In 1914, 16.7 per cent. of those employed in manufacturing industries were women.

Because of the expansion of woman's work and the replacement due to the removal of large numbers of skilled men from industrial service during the war, increasing numbers of inexperienced and unskilled women were inducted into factory work. One result of this has been the introduction of employment service departments to develop new sources of labor, to determine and direct the personnel of the working force, and to standardize the conditions of employment necessary to safeguard the health and the lives of the workers. Another result has been improvement in the processes of production. This has necessitated a realignment of tasks suitable to the workers, increased subdivision of processes, and an increase in the proportionate number of foremen and other supervisors. Changes in construction and equipment have taken place, with the ultimate aim of making the work hazard-proof and error-proof. Systems of training have been introduced together with methods of inducting unskilled women workers into industry and upgrading them during the period of their employment.

The work of the government school for training precision optical operatives is described, also the methods used in the railway service. — G. E. Partridge.

Extent and Effect of Substitution of Women and Girls in Industry. *Miss Anderson.* Ann. Rep. Chief Inspector of Factories and Workshops, Great Britain, for 1917, 10–18. — Very numerous instances are reported for 1917 where women carried out practically the whole of the work of a factory or a branch or process. The new developments for the year are in the employment of women in industries like the following: ship-yard work, blast furnace and forge works, copper works, spelter works, brickmaking, ferro-concrete and other construction work. Relatively few failures have been reported against these workers. Where failures have occurred, the causes may be classified under: (1) insufficient care in selection of appropriate women for the kind of work needed; (2) insufficient care in instruction and training; (3) insufficient care or understanding in adapting and organizing conditions and methods of work to women's needs; (4) opposition on the part of men workers.

Improvement in conditions, organization and methods of work is gradually making clear the fundamental contrast, hitherto hidden by traditional and conventional views as to which were womanly occupations, between new occupations that can and may become more or less permanent for women and those which are preferably only temporary. It has been observed in non-munition factories, where women have been newly introduced as substitutes, that a high proportion of them have come direct from home life and domestic service. This will have an important bearing on the problem of demobilization. A noteworthy fact commented upon is the apparently limited extent of women substitutes in the higher posts of industry. There are a few women managers and foremen in some plants, but they appear to be exceptional cases. A field opening to women is that of welfare supervisor in factories.

Introduction of labor-saving appliances has facilitated very greatly the substitution of women. Adaptation of the sizes and shapes of appliances to the needs of women is another aid. It appears that a number of serious accidents occurred to women workers on account of improper protection of machinery or ignorance of the worker in regard to full details of the process.

As to the physical effects upon the workers, it would seem from the records accessible on general health and sickness that the rates point to an improvement in health rather than the contrary. Analysis is not yet possible of the exact increase in injury to women due directly to accidents from machinery and other causes in occupations newly opened to them, nor of the share which fatigue from exceptional hours necessary in the stress of war-time production should bear in causing industrial accidents. Close following up of health records in absenteeism is indicated as the best aid in health and welfare administration.

Welfare work or "social management" of a factory is stressed as one of the most important phases of administration. Two points that have been studied in the past year are: (1) protective clothing for women workers; and (2) seats for factory workers, especially women. Information has been collected in an effort to formulate later reasonable regulations. — Barnett Cohen.

THE INDUSTRIAL REPLACEMENT OF MEN BY WOMEN IN THE STATE OF NEW YORK. Bull. 93, Dept. Labor, Bur. Women in Industry, State of New York. — In this sixty-nine-page pamphlet is quoted the experience of 117 plants in twenty-six communities in which over 13,000 men were replaced by women. The study covered some seventeen industries. A brief list is given of those processes on which women have found employment in the place of men.

Statistics are quoted which tend to show that the earnings of women engaged in the same capacity as men, and for production in some cases greater, and in others less than men, were often correspondingly lower. Of the 6771 women who were discharged from the number of those who replaced men, only 32.9 per cent. failed because of their own physical, mechanical or temperamental shortcomings.

One of the conclusions arrived at as a result of this study is that, wages and general satisfactoriness remaining equal, women will continue in work formerly done by men. — L. Greenburg.

BRIEF FOR THE EIGHT-HOUR DAY FOR WOMEN. U. S. Bur. Labor Statis., Month. Labor Rev., May, 1919, 8, No. 5, 204–209. — A report of the findings of the Illinois Industrial Survey. In Chicago more then three-fifths of the employers were voluntarily setting the hours for women at less than nine, although the Illinois law permitted a ten-hour day. In these cases we are justified in assuming that business efficiency is the prime consideration, and, since health is an important factor in efficiency, we may conclude that hours in excess of nine impair the health of women workers.

The commission made a study of 4711 women working in Illinois establishments who were asked what effect the occupation had upon their health. In Chicago 51.8 per cent. of the women working sixty-one hours or more per week made complaints, compared to 15.2 per cent. among those working forty-four to forty-eight hours. Likewise a far higher proportion of the permanence was found in the latter group than in the former.

Forty-one industrial physicians, supervising the health of women workers, were asked their opinion as to the best length for the working day for women. Of the thirty-five who answered twenty-six spoke in favor of eight hours.

In three establishments a study was made of the comparative output under different schedules of hours. A decrease from fifty-four or fifty-five hours per week to forty-eight hours yielded an increase in total output of from 2 to 13.4 per cent.

As a result of their investigation, the commission presented four recommendations and a bill, embodying these points, to be passed as a law. — L. A. Shaw.

THE EMPLOYMENT OF CHILDREN IN ENGLAND. School and Society, August 30, 1919, 10, No. 244, 266–267. — The British Home Office has issued a a circular, addressed to local education authorities, with reference to the Education Act of 1918. Although some option is allowed the local authorities, an attempt is made to discourage the employment of children before school hours in the morning, on the ground that it interferes seriously with educational work and often affects the health. The circular deals also with the prohibition of specified occupations, and offers suggestions for establishing a maximum of work, two hours on regular days, five hours on Saturday, and only special occupations on Sunday. Apparently the provision for local by-laws has confused the results of the general act. — G. E. Partridge.

TENTATIVE STANDARDS FOR THE PROTECTION OF CHILDREN ADOPTED BY THE INTERNATIONAL CONFERENCE ON CHILD WELFARE. American Child, August, 1919, 1, No. 2, 96–99. — At a conference held by the Children's Bureau in Washington, May 5–8, at which a number of foreign delegates were present, tentative standards were adopted which should govern children entering employment. The standards adopted are given here in detail. — L. A. Shaw.

CHILD LABOR AND SCHOOL ATTENDANCE. *E. N. Clopper.* American Child, August, 1919, 1, No. 2, 100–106. — It is necessary to define child labor in order to understand the relation existing between child labor and school attendance. Nobody looks upon his own form of child employment as exploitation, and we are all in the habit of confining child labor within the four walls of a spinning-room in a Southern cotton mill. From the information given in the United States Census, we may venture to define child labor as the work done by children under 16 years of age, with or without pay, under direction or independently, which deprives them of their normal measure of play, schooling, rest and healthy development. Generally speaking, child labor excludes school attendance.

The U. S. Public Health Service has already done much toward standardizing the minimum health requirements of children in industry. Along with this movement there is growing a general tendency to establish standards of education as well. This movement for minimum standards and their coordination is not confined to our nation. It is characteristic of the new spirit in international relations. — L. A. Shaw.

THE WELFARE OF THE CHILDREN OF WOMEN EMPLOYED IN FACTORIES IN FRANCE AND GERMANY. — A pamphlet issued by the Intelligence Department of the Local Government Board, London, and prepared originally for the Welfare Advisory Committee of the Ministry of Munitions. — G. E. Partridge.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Planning the Industrial Plant. *H. M. Wharton.* Ind. Management, September, 1919, 58, No. 3, 237–241. — In this, the last of a series of four articles on planning industrial plants, the writer discusses among other things fire protection, toilets and lavatories, heating, ventilation and illumination. His treatment of these questions is confined entirely to their relation to plant construction. He stresses the importance of automatic sprinkler systems and of fire-walls where fire risks are greatest. Careful attention must be paid to the location and the proper equipment of fire-doors. Hydrants and hose equipment should also be adequately provided.

Toilets and lavatories must be installed with special regard to sanitation and light. Wherever feasible, water closets should be separate from locker rooms and wash rooms, and the floors, at least, should be of concrete or some material which can be easily cleaned. Walls should be of a non-absorbing material which cannot be easily defaced. Hard-face brick covered with oil paint will answer this purpose at moderate expense. Rooms containing closets require artificial ventilation. This can be obtained by locating air vents, connected with a ventilating shaft, directly behind the seats. In this way offensive odors are drawn off by a suction fan before they have a chance to circulate in the room.

Ordinary shop rooms where workers are not congested will usually ventilate themselves naturally through cracks between windows and casings, through open doors, etc. Where heavy dust, smoke or fumes exist, special mechanical ventilation must often be applied at their source in order to prevent them from circulating in the room. Artificial heat is commonly obtained in factory buildings from steam delivered to coils or radiators located near points which admit the greatest amount of cold. While hot water and heated air are also employed, they are relatively more costly.

Special care should always be given to natural lighting in constructing a factory. Window space should be adequate. Where necessary, direct sunlight may be excluded by special lighting construction and the use of ribbed glass. Because of the more involved problems connected with artificial lighting, expert advice regarding its choice and installation should be obtained. — C. H. Paull.

What it Pays to Know About Factory Lighting. *C. E. Clewell.* Factory, September, 1919, 23, No. 3, 496–499. — These notes have to do particularly with the arrangement and use of window space. Some of the factors which Mr. Clewell lays stress upon are: (1) relation of window space to floor space, (2) exposure and obstructions outside the building, and (3) kind and condition of glass. He touches upon the relative merits of common and plate glass, ribbed glass, glass re-enforced with wire, and prism glass. He concludes that, under ordinary conditions, ribbed glass is much more desirable than the rough or hammered glass, providing the cost is approximately equal, and that, under certain conditions, prism glass is highly desirable.

The author suggests that a more accurate estimate of the lighting value of window space can be obtained by using as a basis the ratio between exterior and interior intensity of natural lighting at a given time of day, than can be obtained by using a ratio between window area and floor area. The ratio between exterior and interior intensity of natural lighting takes into account not only window space and outside conditions, but also important factors such as the color of the walls within the building. Attention is called to the variation of light at different times of the year. The chart given on page 497 shows graphically the diminished intensity of light for different seasons of the year at different times of the day. — C. H. Paull.

Better Ways to Light the Work. Factory, September, 1919, 23, No. 3, 604, 606, 610, 615. — The series of short contributions under this heading deal with special phases of problems of shop lighting. The comments under "When Lights Are Needed Most" call attention to the importance of making adequate provision for emergency lighting. The emergency factory-lighting rules used in New Jersey are cited here as a minimum to be followed in factories. — C. H. Paull.

Definite Means of Insuring Adequate Illumination in Work Places. *C. C. Rausch.* Safety, July–August, 1919, 7, No. 6, 142–148. — A new foot-candle meter has recently been put on the market. It permits measurement of light falling on any surface and is so compact and so light in weight that it can easily be carried about. It should be of assistance in insuring the adequate illumination of work places. — G. M. Fair.

North Carolina State Board of Health. Health Bull., July, 1919, 34, No. 7, pp. 32. — This pamphlet is devoted to a discussion of the sanitary disposal of human excreta. Following is the table of contents which gives the subdivisions of the subjects as herein treated: Introduction; The State-Wide Privy Law Explained; Sanitary Principles of the Construction of Privies; Types of Improved Privies, Plans and Specifications for Approved Privies; Summary of Rules for Maintenance of Different Types of Privies; Economics of Privy Construction and Maintenance; Machinery and Methods for Enforcing the Law. — L. A. Shaw.

A Fine Installation of Factory Plumbing. Dom. Engin., September 13, 1919, 88, No. 11, 491–494, 532. — A description of the sanitary equipment of the Stewart Manufacturing Company in Chicago, Ill. — G. M. Fair.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Industrial Medical Service. Lancet, June 21, 1919, 196, No. 4999, 1084–1085. — An editorial advocating more preventive medicine and public health work directly in factories, to co-operate with the work done in the community at large on water supply, insanitary dwellings, sewage disposal, etc. This work is really preventive medicine upon the individual worker, and requires specially trained physicians. There should be more post-graduate education available for the necessary special training. — J. C. Aub.

Keeping Workers Well. Factory, September, 1919, 23, No. 3, 596, 598, 600. — A brief statement of the success attained by one plant in reducing absence and increasing output through the opening of a hospital and the establishment of a well-organized system of medical service. — C. H. Paull.

INDUSTRIAL NURSING

The Public Health Nurse's Part in Venereal Disease Control. Commonhealth, Bull. Mass. State Department of Health, May–June, 1919, 6, No. 3, 118–119. — The U. S. Public Health Service in a recent publication calls attention to the inestimable value of public health nurses in reducing the venereal disease rate in cantonment zones, and in keeping down sickness in general. If the public health nursing field is to go on expanding as it should, hospitals must offer proper training facilities. — L. A. Shaw.

INDUSTRIAL, PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

The Greater Community. *W. L. Bailey.* Survey, August 9, 1919, 42, No. 19, 706–707. — Under the inspiration of Dr. F. E. Sampson of Creston, Iowa, there has been developed a form of community health service which reaches six counties. The membership in the Greater Community Association includes churches, schools, lodges, clubs, Red Cross chapters, patriotic societies, parent-teacher associations, and individuals. Among its activities are the maintenance of a community hospital and training school, a school children's dispensary and free clinic, a free dispensary for tuberculosis, a welfare station for children under school age, a health education center, and a psychopathic clinic. — C. H. Paull.

A Model Mining Tropical Village. *Walter E. Masters.* Jour. Trop. Med., May 15, 1919, 22, No. 10, 89–93. — A brief survey indicating what can be done by sanitation and hygiene in a country once known as "The White Man's Grave." The author considers this next to the world-wonder of Panama. Nowhere has he seen such good results accomplished at so little maintenance expense as at Prestea Model Mining Village, Gold Coast Colony. — H. A. Bulger.

Mosquito Eradication in Southeastern Pennsylvania. *B. Franklin Royer* and *C. A. Emerson, Jr.* Am. Jour. Pub. Health, May, 1919, 9, No. 5, 327–332. — The authors describe in some detail the work carried out to lessen the mosquito nuisance in the Delaware River shipbuilding district from Hog Island to below Chester, taking advantage of existing but neglected dykes and flood gates.

From their experiences in inaugurating and carrying out the above work they draw the following conclusions:

1. Mosquito eradication work to be successful should embrace the entire general area where breeding places occur. Limiting the work to political subdivisions, operating independently, is not practical.

2. A comprehensive co-operative project, embracing private corporations, municipal and state agencies, is practical, providing the work is performed in accordance with a comprehensive plan previously approved by the various interests concerned, and general direction of the project placed in some unbiased central organization, so formed either by law or mutual consent that its jurisdiction covers the entire territory. This would seem to indicate that general supervision should be placed in some permanent central authority having uniform powers and responsibilities, such as the state department of health.

3. Benefits of mosquito eradication work are far-reaching, and include increase in value not only of properties within the immediate district but also of general real estate within a wide area. The same applies to the benefits to public health.

4. The powers possessed by most state organizations are not suitable for undertaking work of this nature as a routine procedure. It is desirable that the cost should be borne directly by the properties benefited in proportion to the benefits received, and legislation should be enacted whereby the central authority can assess benefits either by collection of taxes in accordance with the usual practice, or by condemnation and resale of the property. Such legislation should also provide funds for maintenance purposes.

The work carried on under the conditions set forth in this paper has had beneficial results, as is proved by the fact that complaints from residents and work-

ers in the districts were almost unknown this past summer, and that preparations are now being made for the cultivation of large areas of land which for years have remained idle, covered with a luxuriant growth of weeds and water vegetation.

Plans are being prepared for extension of the work next year through the district to the south of that brought under control this past season, and it is hoped that legislation will be enacted whereby this work undertaken as a war measure can become a permanent adjunct of the work of the state department of health, being gradually extended throughout all portions of the state where mosquitoes are sufficiently abundant to interfere with the comfort and the health of the citizens. — H. F. Smyth.

War Activities as They Have Affected Housing, Health and Recreation. *E. W. White.* The Playground, August, 1919, 13, No. 3, 200–202. — "Those who think that the working people of the world are demanding more pay and shorter hours for the sake of the extra income or for a greater number of loafing hours are utterly blind to that deeper motive that is swaying the common thought of the time. The human race has turned a new corner, and now the purely material advance will no longer satisfy. The solution is this: Every avenue must be thrown open for feeding the craving for the inspirational that art satisfies. There must be a shorter working day and more vacations, and there must be organized community service." — G. E. Partridge.

Government Housing at Home and Abroad. *W. E. Shannon.* Am. Industries, September, 1919, 20, No. 2, 25–27. — The writer discusses the financing and the location of housing for workers. He objects to a plan by which the government assists in building for the worker, in that it would involve favoritism and would tend to be paternalistic. He further objects to the financing of housing schemes by industries on the ground that it would put the worker under unjust obligation. A scheme of loans by banks and similar organizations is much to be preferred. The development of housing projects in new areas seems to him uneconomic in cases where it is possible to build in communities where streets, sewers, etc., have already been built. The importance of building the home primarily for comfort is also stressed. — C. H. Paull.

The Seattle Plan of Home-Building. *C. Bush.* Am. Industries, July, 1919, 19, No. 12, 25–26. — An account of a scheme instituted in Seattle to stimulate building. This scheme involved three definite activities: (1) the organization of a building corporation, (2) the organization of a Second Mortgage Company, and (3) the development of a campaign to interest property owners and business men in building houses. The work was under the general direction of a More Homes Bureau. Although no work was done by the Second Mortgage Company, owing to the close of the war, the other agencies operated so successfully that no less than 2000 houses have been built as a result of the movement. — C. H. Paull.

The Labeled Privy. Health Bull., No. Carolina State Board of Health, September, 1919, 34, No. 9, 8–9. — A law has been enacted in the North Carolina State Legislature which specifies that every residence located within 300 yards of another residence must have an improved type of privy, approved by the State Board of Health. It will be the duty of a special inspector to examine each privy, first, as to its construction and second, as to its maintenance, and then to affix a label thereto. — L. A. Shaw.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

Public Health and the Candy Factory. Bull. N. Y. State Ind. Com., August, 1919, 4, No. 11, 209, 219. — This is a brief review of some of the findings (not yet published) of a recent study of the candy industry in New York. Sixty-six factories, large and small, in various parts of the state were visited; the majority of them, however, were in New York City. In general, housing was found to be fair. Girls and women as a whole were not well paid. Eighty-seven and four-tenths per cent. of the women received less than $16.50, the amount which had been established as a minimum for women in Schenectady by the War Labor Board. Sanitary conditions were frequently bad, endangering not only the health of the workers, but also that of the consumer. Arrangements for the personal cleanliness of workers were apt to be inadequate, and in many cases health certificates for workers were not insisted upon in a way which would give the consumer adequate protection. New York City showed the greatest care in this matter. — C. H. Paull.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

Community Service as a Builder of Morale for the Institutions of Civic Life. *L. A. Halsted.* The Playground, August, 1919, 13, No. 3, 190–200. — The writer is district representative of Community Service, and his thesis is that what the War Camp Community Service has done for our military organization in war time, Community Service (Incorporated) will do for the institutions of civil life. It will promote health, arouse enthusiasm for tasks, prevent discouragement, inspire confidence in the

government and in all our social, industrial and religious institutions, provide opportunity for activities such as community singing, supervised public dancing, community club houses, public forums. It will undertake to induce people to engage in constructive leisure-time activities.

The movement is an outgrowth of the activities of the American Playground and Recreation Association which organized the War Camp Community Service, and which has established a national organization under the name of Community Service (Incorporated). This organization will promote all the interests heretofore served by the American Playground and Recreation Association, and in addition will provide suitable leisure-time activities for the whole population. A part of the work will consist in the elaboration of means of bringing together the prejudiced classes, with the purpose of encouraging employers especially to take the initiative in solving the present problems that arise from the social disparity in the industrial world. — G. E. Partridge.

The Community, Home of Lost Talents. *J. Lee.* The Playground, August, 1919, 13, No. 5, 171–176. — The great evil of our industrial civilization is defeated instinct, and because balked expression, not physical need, is at the root of all the social disturbance of the present time, the restoring of expressive life is the one great problem of the day. To some extent the remedy must be sought and found within industry itself. Business must cease to be a wholly private matter, and must be carried on more as the function of all the people, especially of those immediately engaged in production. Education also must be directed toward producing a larger life through experience in art and in play. — G. E. Partridge.

Community Service Through the Schools. *C. F. Weller.* School and Society, September 13, 1919, 10, No. 246, 301–311. — Mr. Weller is special district representative of Community Service (Incorporated). This article is a report of work in Chester, Pennsylvania, the main features of which have been described in another abstract in this journal. — G. E. Partridge.

The Best Thing That Ever Came to Chester. *Florence Samuels.* The Playground, July, 1919, 13, No. 4, 127–142. — This is an interesting account of the application, to the social problems of a city, of the War Community Service idea. Twenty-seven nationalities are represented among the working classes of the city, and the community program has been planned with regard both to the physical welfare and the Americanization of the people. The plan includes a community club for men, recreation centers in the school buildings, an Italian organization, hospitality program, organized singing, a physical recreation program, with games and folk dancing. — G. E. Partridge.

Substitutes for the Saloon. *R. Calkins.* The Playground, August, 1919, 13, No. 3, 176–190. — Experience in recent years has all gone to show that the saloon is in no sense a social necessity and that, therefore, in the present day of complete abolishment of the saloon, the prevalent statement that the need of finding a substitute for the saloon is a social problem is not quite correctly conceived. In general, it has been found that where the saloon has been abolished, the activities which it absorbed and represented have tended to return to normal channels.

Various new plans such as the following are discussed and, for the most part, approved: further development of recreational work, the new activities of the Salvation Army, attention to the establishment of places for public convenience, centers for social gatherings, means of ready distribution of sporting news. There must be a wider use of school properties, and other provisions for meeting the requirements of a return to normal life on the part of the public. — G. E. Partridge.

Keeping Workers Well Shod. Factory, September, 1919, 23, No. 3, 501. — A brief statement of a plan which one employer put into practice to help protect the health of his workers. A shoe-repair shop was installed to render service to all employees at cost. — C. H. Paull.

Employees' Benefit and Pension Schemes. Labour Gazette, August, 1919, 19, No. 8, 863–864. — A description of the mutual benefit society for health insurance which prevails in the Dominion Chain Company of Niagara Falls, Ontario; also a brief summary of the pension scheme inaugurated by the Montreal Shirt and Overall Company. — L. A. Shaw

INDUSTRIAL HEALTH LEGISLATION AND COURT DECISIONS: MALINGERING

Hours of Work and Emergency Orders. *G. Bellhouse.* Ann. Rep. Chief Inspector, Factories and Workshops, Great Britain, for 1917, 5–9. — The tendency to reduce hours, which has been a growing feature since the early days of the war, continues, and cases where women and young persons (protected persons) are employed for hours in excess of the maximum weekly limits allowed are now rare. In a survey of munition works where approximately 27,000 women and girls were employed, there were found 6 cases where the hours actually worked exceeded 60 per week: in 32 cases they amounted to 60; in 62 cases they were between 55 and 60; in 51, between 50 and 55; in 20, between 45 and 50; and in 7 they were less than 45.

Perhaps one of the most interesting features in this connection is the gradually increasing number of cases in which work before breakfast is being abandoned. It seems that this improvement results in: (1) disappearance of bad timekeeping in the morn-

ing; (2) large decrease of sickness among girls in the first hours of the morning, which was common when work started at 6 A.M.; (3) hardly noticeable reduction in output in departments where it depends on the activity of the workers, and not in proportion to the drop of one hour per day even in departments where output depends chiefly upon machine hours; (4) maintenance of better work. The experience of a number of firms is cited to support these points, showing that the " one-break " day is superior to the " two-break " day.

A further development, still in its infancy, is the cessation of all work on Saturdays, with no decrease in the total of hours worked weekly. In the clothing industry this seems to have worked out satisfactorily for the employer and the worker.

Sunday work has been reduced to small dimensions, experience having proved it to be unprofitable and even harmful. Only in special cases where continuous processes have been involved or where there has been an urgent demand for output of munitions has Sunday work been allowed.

Night work for protected persons has still been found necessary because of war conditions. Shifts of longer than twelve hours during the night have been discouraged and disallowed as much as possible. While some long shifts are no doubt undesirable, no complaints from the workers have been recorded, and no evidence of injury to health has been observed so long as the number of shifts has been limited to five turns per week. There has been no general development of the system of eight-hour shifts. Many difficulties, especially the scarcity of labor, seem to have proved a stumbling block to the wide adoption of the system.

Overtime for protected persons is much less general, and there are few cases reported where more than five or six hours a week are worked. Instead of overtime, a rearrangement of hours is being attempted with some satisfaction in non-textile mills.

There appears to be no evidence of undue or excessive fatigue (sufficiently marked to show impairment of efficiency) among the protected workers observed. Little further evidence has been gained as to the effects of overtime on output.

There has been a most remarkable change of attitude of the magistrates and press in regard to violations of the Factory Acts. Whereas early in the war prosecutions for illegal hours were strongly criticised and unsuccessful, they are now regarded with sympathy. — Barnett Cohen.

Labor Legislation of 1918. U. S. Dept. Labor, Bull. No. 257, June, 1919, pp. 169. — An article giving a review of labor legislation of 1918, and the laws of various states relating to labor enacted since January 1, 1918. — L. A. Shaw.

Report of the Department of Labor, State of New Jersey, 1918, pp. 54. — A report concerning the work of the Department of Labor in the State of New Jersey from November 1, 1917 to July 1, 1918. Among the articles which this report includes are the following: Activities of the Bureau of Hygiene and Sanitation; Activities of the Workmen's Compensation Bureau; Report of the Industrial Accident Bureau; Physical Efficiency and Occupational Disease. — L. A. Shaw.

WORKMEN'S COMPENSATION AND INSURANCE

What the Term " Medical Service " in Workmen's Compensation Laws Includes. *M. C. Fricke, Jr.* U. S. Bur. Labor Statis., Month. Labor Rev., July, 1919, 9, No. 1, 187–205. — The writer makes an analysis of what is meant by the term " medical service " in various states and administrative districts in the United States. He bases his discussion on actual provisions in compensation laws and upon decisions which have been rendered by commissions and by courts. States can be roughly grouped into two classes: (1) those whose compensation laws are explicit and detailed with regard to medical service, and (2) those in which the laws are not explicit and detailed. When questions have been left to courts and commissions, the decisions have, in general, been as liberal to the workers as possible.

Compensation laws can be grouped under three heads as regards extent of service rendered: (1) those which make no provision for medical aid except in case of last illness, (2) those which place no restriction except that of reasonableness and necessity, and (3) those which specify time and money limitations. A well-constructed table presents this information by states. There is considerable variation and in certain states considerable uncertainty as to the time at which medical service shall begin. In six states the date of disability is specified as the beginning of the period when medical service is provided; in sixteen, the date of injury is specified; in three states no time is specified for the commencement of medical service.

The scope of medical service for various states is worked out in a chart (page 194) which shows states providing (1) medical, surgical, and hospital service, (2) medical and surgical supplies, (3) nursing, (4) medicines, (5) artificial members, (6) crutches, (7) apparatus, (8) transportation to hospital or physician. In general, medical service other than that provided by persons regularly admitted to the practice of medicine is not recognized under compensation laws. — C. H. Paull.

Provision for Second Injuries Under Workmen's Compensation Laws. *C. Hookstadt.* U. S. Bur. Labor Statis., Month. Labor Rev., July, 1919, 9, No. 1, 206–211. — This discussion deals with the problem of discrimination against disabled workers by employers because of the operation of compensation laws. Believing that a disabled worker is a greater risk and more apt to be permanently dis-

abled, employers are often unwilling to expose themselves to the operation of existing compensation laws. In thirteen states compensation is granted only for disability caused by the particular injury under consideration, regardless of previous injuries. While such a law reduces discrimination against disabled workers, it does not offer sufficient protection to the worker in cases where a second injury augments the handicap of a first injury to the extent of permanent incapacity.

In fourteen states compensation is granted for the entire disability caused by the combined injuries. This places a heavy burden upon the last employer of the injured worker. New York and four other states have provided that in case of a second injury the employer compensates only for the disability arising from that injury, while the state pays an amount which would bring the total compensation to a figure equal to the compensation for the combined injuries. By this plan the employer is relieved of unusual burden in the case of second disability. In six states, compensation for second disability is based upon the difference between the final disability and the prior disability. Eleven states make no specific provision regarding second disability. In a few other cases, somewhat different schemes are in operation. The writer favors the New York State procedure as being the least unfair to both the employer and the worker.

In caring for men disabled through war, the writer advocates that the federal government introduce a scheme by which it will reimburse employers for compensation paid in case of permanent disability, injuries or death. — C. H. Paull.

Direct Settlements Under New York Compensation Law. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 253–255. — Nearly all compensation laws in the United States permit direct settlements between the employer and the employee in industrial accident cases. The original Compensation Act of New York required the Compensation Commission to adjudicate all cases, but an amendment in 1915 permitted direct settlements.

A report from a commission of investigation states that conditions resulting from direct settlement are shocking; that in 50 per cent. of the cases thus settled the claimant is underpaid; and that the records are so kept that it is impossible to determine the extent of disability, the character of the injury, or the amount of compensation paid. As a result the commission recommends an amendment to the compensation law, abolishing direct settlements and requiring the commission to pass upon all cases. — L. A. Shaw.

Workmen's Compensation Legislation in Missouri, North Dakota, and Tennessee. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 255–259. — A brief statement of the salient points in the recently enacted compensation laws in these states, with a particular reference to the weaknesses of the new law in Tennessee. — C. H. Paull.

Medical Administration of Health Insurance. *Woods Hutchinson*. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 285–292. — Dr. Hutchinson points out several essentials of health insurance as he sees them in connection with the work of the Social Insurance Commission of California. He emphasizes the importance of a capitation system of payment for medical service as the keynote of the medical administration of health insurance in that it leaves the individual free to seek medical service at any time at no added cost, and in that it distributes the cost of medical service evenly over good and bad years and gives the fortunate and unfortunate equal protection. Regarding co-operation from physicians he points out that experience in England has shown the willingness of doctors to co-operate in such a scheme. The article goes into the organization of state medical service as regards supervision, provision of specialists and hospital facilities. — C. H. Paull.

Report on Health Insurance and Old-Age Pensions. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 270–284. — A reprint of the recommendations of the 1919 report of the California Social Insurance Commission, including a brief statement of the history of the movement in California. Both the majority and minority reports are included. Among the important features of the report of the majority are the favoring of a compulsory scheme with certain stated limitations; the payment of premiums based upon wages rather than a flat rate; the payment of an amount for disability based upon wages; the carrying of insurance by state or other agencies; the free choice of physician by the insured; a thorough plan for state and local administration of the act.

Among the points made in the minority report are the necessity for a flat rate which would protect equally all citizens; the desirability of having a simple flat rate of payment for disability; the danger of establishing class distinction by making insurance compulsory only among certain groups; the importance of exempting those with conscientious scruples; the desirability of having state insurance clearly distinguished from similar insurance by other agencies. — C. H. Paull.

The Economic and Political Bases of State Insurance Against Sickness. *L. Verney*. Policlinico, June 29, 1919, 26, No. 26, 817–825. — Several bills for sickness insurance of the working classes are at present before the Italian legislature. It is expected that the insurance will take in about ten or twelve millions of persons. The bills are generally fashioned after the British law. The insured are expected to contribute to the insurance fund according to their means, and in case of sickness the insured are permitted to select the physician they desire. The author is very much in favor of insurance and thinks that the position of the medical practitioner will thereby be very much improved. — A. Allemann.

REHABILITATION OF DISABLED EMPLOYEES

Disabled Soldiers and Sailors: Pensions and Training. *E. T. Devine* assisted by *L. Brandt.* Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 12, 1919, pp. 471. — *Part I* treats of the disabilities caused by the world war. *Part II* is an historical survey of the attitude toward and the disposition made of disabled soldiers and sailors in the past. *Part III* traces the current development of the restoration and reemployment of disabled men in Great Britain, Canada, France, Germany, Austria and United States. *Part IV* discusses the new program including physical restoration, financial indemnities, and economic re-establishment. — L. A. Shaw.

Plan to Prevent Discrimination Against Employment of Military Cripples in Great Britain. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 70–73. — This is a brief summary of the findings of a committee appointed by the Secretary of the Home Office. The committee, after investigation, could find no satisfactory statistical basis for a conclusion that the disabled man was a greater industrial risk than the able-bodied worker. On the other hand, there was a consensus of opinion that, particularly in the more hazardous occupations, he would be less satisfactory.

Because of this fact and because of keen competition anticipated with the resumption of normal business, the committee felt that the employer should be encouraged in hiring disabled men by removing the possibility of unusual liability. Three possible schemes were suggested, and the third of these recommended as a basis for action.

1. The bearing of the extra insurance liability by the man himself.
2. The bearing of the added liability by the trade as a whole.
3. Assumption of the added liability by the state.

In the plan finally recommended the insurance companies would be required to insure the disabled worker at the ordinary rate, and the state would make itself responsible for any excess charges in compensation arising from the state of previous disability of the worker. — C. H. Paull.

Report on Industrial Consequences of Permanent Disabilities in California. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1919, 8, No. 6, 247–253. — A comprehensive investigation of the economic handicap suffered by permanently disabled industrial workers, made by the California Industrial Accident Commission.

From January 1, 1914, to June 30, 1918, there were 7500 industrial injuries in the state of California. Of these 15 per cent. were permanent injuries serious enough to constitute a handicap. Of the permanently injured, about 30 per cent. were unemployed. According to the report, industrial re-education is the solution. Costs are given to cover a six months' educational period. The commission concludes that economically, not to mention other considerations, the money so spent would constitute a splendid investment. — L. A. Shaw.

Opportunities for Handicapped Men in the Rubber Industry. *B. J. Morris* and *C. H. Paull.* Publications of the Red Cross Institute for Crippled and Disabled Men. June 14, 1919, Series 11, No. 9, pp. 125. — An article giving in detail the processes involved in the rubber industry and the type of disability which is best suited to each process. — L. A. Shaw.

Abstract of Proposed Plan for the Psychic Rehabilitation of Psychopathic and Neuro-psychopathic Soldiers. *E. W. Lazell.* The Psychoanalytic Review, July, 1919, 6, No. 3, 350–352. — There is need of prompt and thorough attention to the problem of the mental restoration of the great number of soldiers who have been mentally damaged by the experiences of the war, or in whom the war has brought to the front inherent mental deficiencies. Shell-shock is to be interpreted in terms of a psychic condition requiring analysis and re-education. Workers must be trained and organized to deal with these cases, and for this purpose courses should be given in the state universities. Rehabilitation consists mainly of character-building through cultural work combined with gymnastic and vocational work. — G. E. Partridge.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME I — DECEMBER, 1919 — NUMBER 8

CONTENTS

GENERAL

OCCUPATION HAZARDS AND DIAGNOSTIC SIGNS. A GUIDE FOR MEDICAL EXAMINERS REGARDING IMPAIRMENTS TO BE LOOKED FOR IN HAZARDOUS OCCUPATIONS. Metropolitan Life Insurance Company, 1918. — This tiny booklet, issued by the Metropolitan Life Insurance Company for the instruction of its medical examiners, is, so one surmises, prepared by Dr. Louis I. Dublin, who is to be congratulated on his achievement. The material is stated to be derived in part from Bulletin 100 of the U. S. Bureau of Labor Statistics, the *List of Industrial Poisons*, compiled by Sommerfeld and Fischer, but it is much more concise, it is modified to cover more nearly American conditions in industry, and its value is enhanced by a cross-reference index which enables the reader to run down a suspected occupation and discover the hazards in it. The fifteen pages make up a slim little pamphlet which can be carried in a pocket book, and the information crammed into it will be of service not only to insurance examiners but to any physician whose practice brings him in contact with men and women employed in the many processes of our complicated modern industry.

Dr. Dublin does not attempt to present a complete scheme of occupational hazards, he contents himself with listing them simply under four heads: dusts, heat, humidity and poisons, and under the last he gives twenty-four poisonous substances. For each of these there is a list of the various occupations in which the poison in question is encountered and the symptoms set up by it. Following this is an alphabetical list of hazardous occupations with references back to the first list. Thus a physician can consult the first list for the symptoms of anilin poisoning and for the occupations in which it is used, or, if he suspects occupational poisoning in a rubber compounder, he can look up rubber compounding and find all the toxic substances used, among which will be anilin.

Doubtless Dr. Dublin would not claim either comprehensiveness or complete accuracy for this little book and the fact that there are occasional lapses to be found in it does not mean that his work has not been, on the whole, admirably done. A few instances may be mentioned which should be corrected in a later edition. Thus under "Dust," we find cyanamid manufacture mentioned, but not

felt-hat making nor the furriers' trade. Now the first is a rare occupation, the last two are common and employ many people. Moreover cyanamid dust is not inert, it has decidedly toxic qualities and should rightly come under the head of poisons. Perhaps it is unnecessary to include laundry work under the heading "Humidity," it is so notorious, but it is a serious mistake to choose composing as the occupation in the printers' trade which involves exposure to lead and not mention stereotyping and electrotyping, in both of which the exposure is greater. In like manner, lithograph artists are put under lead workers, but litho-transfer workers are omitted, although they suffer far more from lead poisoning. Under the industries in which there is danger of H_2S poisoning should come the manufacture of sulphur dyes, especially khaki and browns. Phenol manufacture carries with it the danger not only of phenol poisoning, but of benzol. Only recently there were two deaths from benzol in this industry.

Naturally it will be necessary to revise such a guide from time to time and bring it up to date, for industry changes so quickly. Even now the list of poisons in the rubber industry is incomplete. New volatile poisons are coming into use there that expose not only compounders and mixers but even steam vulcanizers. This is an enormous task for one man but Dr. Dublin's first attempt is so nearly successful that we must hope he will continue his work in this field. — Alice Hamilton.

Industrial Hazards. *Royal Meeker.* U. S. Bur. Labor Statis., Month. Labor Rev., Sept., 1919, 9, No. 3, 1-8. — In this paper Dr. Meeker takes a stand which is novel in the United States though held for many years by experts in Europe, namely that the usual interpretation of an industrial hazard is too narrow, that the term should cover "anything occurring within an industry which impairs the earning power of a worker," and that the effects of industrial poisoning and disease are even more disastrous and far-reaching than those of accidents. There is no clear line of demarcation between industrial accident and disease. "The loss of the use of a hand affects the health of the worker just as vitally whether his disability is caused by an exposed gear or by lead poisoning. The economic effects of disabilities are the same, no matter how produced." Consequently industrial illness, so far as industry can be held responsible for it should come under the same compensation laws as industrial accidents. It is the difficulty in proving responsibility that presents the great obstacle to proper compensation for industrial disease. Dr. Meeker believes that this responsibility is far greater than is generally admitted, that industry is a contributing factor in ill health even more than in accidental injuries. That it is difficult to rule out the influence of home conditions, bad housing, infected water supply, and so on, he admits, but industry cannot disclaim its share because other factors have a share also.

By far the most important of all industrial diseases is fatigue. Here too Dr. Meeker takes in account the usual defense of the employer that his workers are exhausted by unwholesome amusements and not by their employment, but he thinks that source of fatigue negligible in importance compared to the fatigue of monotonous work under bad conditions, and he insists also that this very sort of work brings on a craving for excitement and even dissipation. Accumulated fatigue is probably the cause of a very great deal of sickness not thus far attributed to industry and for this he believes that bad construction and bad management of industrial establishments is chiefly responsible, and that intelligent management could eliminate these evils with an enormous resulting benefit to production and to producers. Dr. Meeker risks the wrath of the employing class by asserting that not less than half the illness in the country, probably more than half, originates in and grows directly out of employment.

In discussing accidents, also, the responsibility of the employer is emphasized. Far too much stress has been laid on the supposed carelessness of the employee and on the necessity of educating him in "Safety First." The studies into causes and results of accidents made by the Bureau of Labor Statistics tend to show that the severer class of accidents are due more to defects in lay-out and construction of plants than to carelessness of the employed. Therefore, while educational work among the force is valuable, the first thing is to do away with these dangers over which the worker's control is very slight.

As this view of the distribution of responsibility is unusual, it is worth quoting Dr. Meeker's conclusion: "Education in industrial hygiene is a matter mostly for employers. Every intelligent employer has competent machinists to look after the injuries to his machines. If a valuable, universal screw machine meets with a mishap, it is given a vacation, with pay, until the machine surgeon repairs the injury. . . . If an engine lathe contracts industrial fatigue, it is given a rest and thorough overhauling. The employer must be assisted to comprehend that his workmen deserve at least as humane treatment as his machines and mules."

There are also in this same paper two interesting sections on unemployment and unemployment insurance. — Alice Hamilton.

The Relation of the Railroads to the Public Health. Public Health, Mich. Dept. Health, Oct., 1919, 6, No. 10, 452-456. Abstracted in Journal of Industrial Hygiene, October, 1919, Vol. 1, No. 6, p. 85.

What the Federal Government is Doing for Industrial Hygiene. *B. J. Newman.* National Conference of Social Work, Pamphlet 194, pp. 4. — During the war, control over all health problems affecting industrial workers was turned over to the United States Public Health Service. At the termination of the war, this department co-operated with the Working Conditions Service. Hazards inherent in old machinery, temperature extremes,

fatigue, substances used in processing, industrial poisonings, ventilation, surgical and medical supervision, first aid and hospital care, etc., were some of the problems investigated with a view to promoting maximum health and efficiency among the workers. The corps continued to do its work after the war at the request of the plants. Furthermore, the service was extended into the community itself. Thus, several towns within industrial zones have been surveyed that the hazards arising from improper sewage disposal, from the use of a non-potable water, and the occupancy of insanitary dwellings might be noted and plans made for their correction. Problems of responsibility for accidents or sickness, and the efficiency of the medical and surgical departments of industries, first under government control and later under private management, have been handled by this service. L. A. Shaw.

The Road to the Eight-Hour Day. *Stephan Bauer.* (Translated by Alfred Maylander.) U. S. Bur. Labor Statis., Month. Labor Rev., Aug., 1919, 9, No. 2, 41–66. The writer discusses this subject under three headings: (1) the international origins; (2) the age of international experiments with the eight-hour day; (3) social revolutions and international solutions.

"The cradle of the eight-hour day is to be found in five countries: in Germany, England, Australia, America, and France." The relation of the eight-hour day in these countries to production and the employment of children and women is discussed in connection with various occupations involved in the movement. Looking upon the eight-hour day in the light of an experiment the writer sees in the future a gradual transition to the eight-hour day. This transition will not reduce production because of improved mechanical devices and innovations in technique and organization. The introduction of the eight-hour day universally will result in the betterment of conditions for juveniles and women in industry. — C. H. Paull.

The Eight-Hour Day in a Small Training School. *F. L. Wetmore* and *L. Goeppinger.* Am. Jour. Nursing, August, 1919, 19, No. 11, 873–877. The eight-hour law should be adopted by the training schools for nurses. The day should be divided in such a way that the nurse is apportioned eight hours of practical work, eight hours of recreation, and eight hours of rest. Not until some such arrangement has been adopted will high-grade women look with favor upon nursing as a profession. — L. A. Shaw.

Labor Problems and Labor Legislation. *John B. Andrews.* Publication of the American Association for Labor Legislation, 1919, pp. 136. — In this very interesting and comprehensive little book the author presents in a simple and very lucid manner a discussion of the legislative aspects of the social and hygienic safeguards of employment. The healthful and efficient employment of labor is not an individual problem but rather one of deep social importance, and as such is to be met with that weapon of society that strives for the greatest good for all, namely, the law.

The book is divided into eight chapters dealing with employment, wages, hours, safety, health, self-government in industry, social insurance, and enforcement by laws. Each of these topics is discussed briefly, and the effect, tendencies, and deficiencies of legislation are clearly brought out. L. Greenburg.

New York State Labor Law with Amendments, Additions and Annotations to August 1, 1919. Issued under the direction of the Industrial Commission. This is a pamphlet of 191 pages containing the general Labor Law of New York state, the penal provisions relating thereto, and references to all amending acts since 1909. A full index appears at the end of the pamphlet. K. R. Drinker.

Thirty-Sixth Annual Report of the State Board of Health of Missouri. Bureau of Vital Statistics, 1917–18. A report of 393 pages stating the activities of the Missouri State Board of Health during 1918, with extensive statistical tables. Services rendered fall under four main divisions: (1) Bureau of Medical Licensure; (2) Contagious Diseases; (3) Laboratory; (4) Bureau of Vital Statistics. — L. A. Shaw.

Interallied Congress for Social Hygiene, Section of Industrial Hygiene. Presse méd., June 19, 1919, 34, 462. — The Section resolves:

"1. That the Minister of Industrial Reconstruction, in co-operation with the Minister of Labor, shall indicate to manufacturers, who may be interested, the requirements of the labor law, either textually or directly.

"2. That manufacturers be notified that they may obtain useful advice from the safety societies in regard to the organization of hygienic and safety measures in factories." — T. J. Putnam.

The United States Employment Service. *N. A. Smyth.* The National Civic Federation Review, January 25, 1919, 4, No. 8, 19–20. — The paper describes the work of the Government Employment Service during the war and leads to the argument that some form of centralized employment service should become permanent. What is needed is not a completely federal service, but a federated system in which there shall be an intercommunicating chain of employment services, the federal government furnishing the intercommunication and keeping up the standards. This, the writer thinks, is a national necessity. G. E. Partridge.

Nation-State Employment Service. Am. Labor Legis. Rev., June, 1919, 9, No. 2, 195–198. — A brief statement of the needs for a permanent employment service which shall involve co-operation between state and federal agencies in providing adequate facilities for the employment and distribution of labor. This article contains an outline of a bill

adopted at the conference on employment held in April at Washington. The bill provides the organization and procedure for full and permanent co-operation of public agencies in solving employment problems. It is upon this outline that the Kenyon-Nolan bills are based. — C. H. Paull.

Immigration, Past and Future. *W. G. Smith.* Canad. Jour. Ment. Hyg., April, 1919, 1, No. 1, 47–57. — The paper begins with a review of the history of immigration into Canada, showing the great need of government control, and the satisfactory results of such control during the last few years. Between 1900 and 1908, the influx was great, but among the immigrants were so many misfits and undesirables that in 1908 an Order-in-Council was passed to prevent Canada from being used any more as a dumping ground. — S. Cobb.

Immigration and the Canadian National Committee for Mental Hygiene. *L. D. Pagé.* Canad. Jour. Ment. Hyg., April, 1919, 1, No. 1, 58–61. — The great number of foreign-born, mental defectives and insane found in Canadian institutions shows the importance of psychiatric supervision of immigration, especially if the population of Canada is to be doubled in the next ten years, as has been predicted. Interest in this problem has been aroused by the Committee for Mental Hygiene, particularly in western Canada. The committee recommends that mental examinations be carried out at the ports of embarkation and on board the ships rather than at the ports of arrival. — S. Cobb.

Survey of the Province of Manitoba. Public Welfare Commission of Manitoba. Canad. Jour. Ment. Hyg., April, 1919, 1, No. 1, 77–82. — A survey was made by the Public Welfare Commission of Manitoba and the following principal recommendations were made: That insane hospitals be put on a similar basis with general hospitals, and that special institutions be set aside for defective patients, as they are a totally different problem from the insane. This is important since the birth rate among defectives is fearfully high and the influence of heredity is strong. A surprisingly large proportion of the defectives have come from the immigrant class. The care of the defectives is not difficult because they can be practically self-supporting; although they are incapable of planning work, they often can be trained to a high degree of manual dexterity and can be used in various industries. — S. Cobb.

Industrial Training, a Way Out. *H. E. Miles.* The National Civic Federation Review, April 10, 1919, 4, No. 12, 2–3, 19. — This is a somewhat popular statement of the work of the Committee on Industrial Training, appointed by the Committee on Labor of the Council of National Defense. The work of the committee, the writer maintains, illustrates the fact that there are many fields of "extreme and common concern to wage earners and their employers in which they should aggressively co-operate."

Several results were conspicuous. It was shown that by intensive training in special operations a high degree of skill could be produced very rapidly; and the work of the "vestibule schools," or training departments in war factories, showed that the skill, happiness, loyalty and accomplishment of workers may be about what the employers choose to make them. It is now known that by a little training of the right kind almost any employer can obtain from 20 to 40 per cent. more from his present workers, to the increased satisfaction also of the workers, since men dislike to do what they do poorly and enjoy doing what they do well. Some charts are shown, indicating that, in some processes, output of a man may be doubled by a few weeks of special education. — G. E. Partridge.

Sight Saving Schools. *N. B. Harman.* School Hygiene, March, 1919, 10, No. 1, 1–14. — This paper is of interest mainly from the educational point of view, but the industrial future of myopic children is taken into account. Special schools for the short-sighted should be closely associated with regular schools, in order not to leave the stamp of abnormality upon the myopic class. Special instruction is outlined, but the scheme of work, the writer says, is nothing more than the application of common sense. Outdoor work involving standing and moving is most suitable for this class of children. For boys, the first selection includes nursery gardening, poultry farming, messenger service, work as assurance agents, travelers, canvassers, rent collectors, hawkers, street traders, waiters and hair-dressers, shopwork under good conditions, and piano-tuning. For girls, work as florists, waitresses, under-nursemaids, helpers in mothers' centers, and light warehouse work are included. At present there are twenty-one schools for myopes in London. Ten years or so ago, opthalmic surgeons were accustomed to forbid school to their highly myopic patients. Now they refer them for admission to the myopic class. — G. E. Partridge.

Some Essentials in Teacher Training as they Apply to Trades and Industries. *J. McKinney.* Manual Training Magazine, October, 1919, 21, No. 2, 41–45. — Because both practical experience in a trade and special training in teaching are required to make a good industrial teacher, and because the right combination is rare, there is much ineffective industrial teaching at the present time. The course of study for the trade teacher has as its central problem the changing of the point of view of a man skilled in productive activity from that of a producer to that of an instructor, and usually the mechanic does not know that this change is profound. The college lecture method is not enough. Observation and practice work in actual teaching are necessary parts of the training. Finally, the trade teacher must be made to see his trade in the largest possible way, so that he can make it a tool of a thorough educative process for the learner, and introduce him

thereby to a life with an outlook. Teaching ability of this sort needs to be cultivated. — G. E. Partridge.

The Teacher as a Social Worker. *J. T. Williams.* Education, March, 1919, 39, No. 7, 424–430. — We need a new conception of the function of the teacher that will include a recognition of the necessity, in any scheme of education, for an ideal of a healthy body and a wholesome environment. The teacher of the future must be a social worker as well as an imparter of knowledge and must have far better training in hygiene than he has now. It is to the unfavorable home that the work which has its center in the school must bring definite improvement and education. Especially in the rural community is there demanded a more social principle in education. — G. E. Partridge.

After the Lean Years. Impressions of Food Conditions in Germany when Peace was Signed. *Jane Addams* and *Alice Hamilton.* Survey, Sept. 6, 1919, 42, No. 23, 793–797. — An account of observations made in Germany by the writers. They point out that, although hostilities are ended, Germany has been so stripped of certain food resources that her need will last for a long time. Conditions among children and young adults demanded much of the writers' attention. It was found that tuberculosis had developed alarmingly, both as to number of cases and severity of types. Rickets was "enormously prevalent" among children. Intestinal diseases of all kinds were greatly increased. Due to lack of soap, proper conditions of cleanliness both among the well and the sick could not be maintained. A general condition of undernourishment and malnourishment was found to prevail. Although the harvests of the present year will furnish an immediate supply of vegetables and grain, there will still be a dangerous lack of fats and albuminous foods unless much outside assistance is rendered. — C. H. Paull.

The Reorganization of the General Abattoir of La Villette. *M. H. Martel.* Rev. d'hyg., March, 1919, 41, No. 3, 224–235. — The Board of Health of the city of Paris has decided that the new abattoir to be erected in La Villette must be conducted throughout after the plan of an industrial establishment. The author, who is a member of the Board of Health, states that the so-called modern abattoirs of the cities of central Europe do not come up to the standards of modern hygiene. The industrial abattoir with four or five stories, as it is found in the United States, alone can fill the requirements of modern hygiene and modern economics. In the old abattoir of La Villette, cleanliness was lacking and the workmen maltreated the animals while driving them to the place of killing. In America the rules require that the animals be treated gently as brutality has a harmful effect on the meat products. The Board of Health proposes to introduce in the new abattoir in La Villette the American methods of slaughtering, sanitation and inspection. It may be conducted under the management of the city, a syndicate or a private individual. — A. Allemann.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT, AND PREVENTION

Cancer Poster of the National Safety Council. — A new cancer poster for use in industrial establishments has just been issued by the National Safety Council. Copies of this poster may be purchased at cost from the National Safety Council, 168 North Michigan Ave., Chicago. — K. R. Drinker.

CENTRAL NERVOUS SYSTEM

Bulbar Syndrome of the Coal Miners. *Benoit.* Scalpel, May 17, 1919, 72, No. 8, 141–154. — The author presents two cases with subjective symptoms of miners' nystagmus but almost no objective nystagmus, except when this is induced by having the miner sitting on a revolving chair.

A number of miners, free of any subjective symptoms, were then compared with workmen who never had been in a mine: nystagmus was induced with the revolving chair; it was always much more pronounced in the case of the miners than in the case of the other workmen. So B. believes that the exaggerated atmospheric pressure under which the miners are working causes a labyrinthic hyperesthesia; this may then increase till the characteristic miners' nystagmus develops. The origin of this disease is in the labyrinth, and not in the eye. The nystagmus is only a symptom of the labyrinthic trouble. — René Sand.

CIRCULATORY SYSTEM

Report upon Soldiers Returned as Cases of "Disordered Action of the Heart" (D. A. H.) or "Valvular Disease of the Heart" (V. D. H.). National Health Insurance, Medical Research Committee, London, H. M. Stationery Office, 1918, 79 pp. — The larger part of this pamphlet is a detailed report upon the effort syndrome, or soldier's heart, as seen in the British army. The origin, diagnosis, course, and treatment of this important condition are fully dealt with. In addition, there is given a valuable outline of the procedure for the sorting of military patients suffering from cardiac disorders, which should be of particular interest to physicians engaged in examining large bodies of men for fitness to do heavy work. — T. J. Putnam.

Studies on Epinephrin. I. Effects of the Injection of Epinephrin in Soldiers with "Irrit-

ABLE HEART." *Joseph T. Wearn* and *Cyrus C. Sturgis.* Arch. Int. Med., Sept. 15, 1919, 24, No. 3. Pp. 247–268.

2. THE EFFECTS OF EPINEPHRIN ON THE BASAL METABOLISM IN SOLDIERS WITH "IRRITABLE HEART," IN HYPERTHYROIDISM AND IN NORMAL MEN. *Edna H. Tompkins, Cyrus C. Sturgis* and *Joseph T. Wearn.* Pp. 269–283.

3. EFFECT OF EPINEPHRIN ON THE ELECTROCARDIOGRAM OF PATIENTS WITH "IRRITABLE HEART." *Harry D. Clough.* Pp. 284–294.

THE POSSIBILITIES OF PHYSICAL DEVELOPMENT IN CASES OF EFFORT SYNDROME BY MEANS OF GRADED EXERCISES. *Bertrand Smith.* Pp. 321–331.

These four articles are studies of the different aspects of the problem of "Irritable Heart." — W. Herman.

RESPIRATORY SYSTEM

OBSERVATIONS ON THE VITAL CAPACITY OF THE LUNGS IN CASES OF "IRRITABLE HEART." *S. A. Levine* and *F. N. Wilson.* Heart, July 22, 1919, 7, No. 2, 53–61. — The authors summarize the results of their experiments as follows: "The average vital capacity is slightly but definitely reduced in the severe cases of 'disordered action of the heart.'" The reduction is not sufficiently constant to be of use in classifying these patients, nor is it sufficiently great to account for the breathlessness which they show so rapidly on exertion. The slight reduction in the vital capacity is due partly, if not altogether, to the discomfort which the severe cases experience in deep breathing, and to fatigue.

"Exercise considerably reduces the vital capacity in severe 'D. A. H.' But since exercise, sufficiently strenuous to produce breathlessness in normal individuals, does not materially reduce vital capacity in these, breathlessness cannot be regarded as the cause of the reduced vital capacity in severe 'D. A. H.' cases." — C. C. Lund.

THE LUNGS AND BREATHING IN WIND-INSTRUMENT PLAYERS. A contribution to the Question of the Development of Emphysema. *N. Jagić* and *J. Lipiner.* Wien. klin. Woch., July 3, 1919, 32, No. 27, 714 (*Concluded*). — A study of the mechanism of breathing in players of different classes of wind instruments. Expert performers, like trained singers, demonstrated excellent control of volume and tone by means of the abdominal muscles and diaphragm. There was found no convincing evidence that playing of such instruments leads to the development of emphysema. — Barnett Cohen.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

METHOD OF TESTING GAS MASKS AND ABSORBENTS. *A. C. Fieldner, G. G. Oberfell, M. C. Teague* and *J. N. Lawrence.* Jour. Indust. and Engin. Chem., June 19, 1919, 11, No. 6, 519–540. — The authors discuss:

1. Absorbent tests which are used in the development and control of absorbent production.

2. Machine canister tests, used in the development of canisters and in controlling the uniformity of filling the canisters at the factory.

3. Actual man tests, in which men wear the masks in gas chambers, to determine the life of the canister, maximum protection, leakage, comfort, and fit of the facepiece. — Worth Hale.

PROTECTION AFFORDED BY ARMY GAS MASKS AGAINST VARIOUS INDUSTRIAL GASES. *A. C. Fieldner, M. C. Teague* and *J. H. Yoe.* Jour. Indust. and Engin. Chem., July, 1919, 11, No. 7, 622–623. The authors state that the army mask should not be used in atmospheres containing less than 12 per cent. oxygen nor in atmospheres containing a large per cent. of toxic gases. The standard filling of charcoal and soda-lime is efficient for a general group of toxic gases but specific gases may be excluded better by either soda-lime or charcoal, depending on the power of absorption of these elements. Carbon monoxide is not removed. In the absence of this gas the mask containing filter pads protects against smoke. — Worth Hale.

A NEW ABSORBENT FOR AMMONIA RESPIRATORS. *G. St. J. Perrott, Max Yablick* and *A. C. Fieldner.* Jour. Indust. and Engin. Chem., November 1, 1919, 11, No. 11, 1013–1016. — Protection for workmen in industries where ammonia is used is needed because of the escaping gas, frequently up to 2 per cent. Pumice stone impregnated with copper sulphate is shown to have a large capacity for absorbing ammonia. A canister containing 45 cu. in. of this material will protect a man at rest for at least five hours against 2 per cent. ammonia and for two and one-half hours against 5 per cent. ammonia. Tests under exertion show that protection is afforded equally well. Several other salts and boric and silicic acids are also good absorbents. The advantages of these absorbents are large capacity, negligible heat absorption and cheapness. — Worth Hale.

EXPERIENCES WITH TOXICOLOGICAL SUBSTANCES EMPLOYED BY SOLDIERS TO PRODUCE SELF-INFLICTED INJURIES. *P. Pick* and *R. Wasicky.* Original in M. Kl., 1919, p. 6. Following is a translation of the abstract in Therap. Monatsh., April, 1919, 33, No. 4, 158–159. — The writer examined many substances used by soldiers to produce self-inflicted injuries. To cause ulceration and inflammation of the skin, plants, drugs, insects, etc., were commonly resorted to, as for instance, hellebore, anemone, tobacco, and members of the liliaceae and

iridaceae, and very frequently turpentine. Cantharides plasters were also employed. Among the chemical irritants, acids, alkalies, metallic salts, soaps and petroleum may be mentioned. The same agents were used to simulate diseases of the genitalia, eyes or ears. To induce internal injuries other agents were employed, particularly picric acid and lactophenin, to produce jaundice; various drastics, and sometimes saffron, for their injurious effects upon the gastro-intestinal tract; digitalis, nicotin and purin derivatives for their heart action, and occasionally potassium chromate or turpentine for their irritating effects on the kidneys. — G. B. Wislocki.

On the Occurrence of Toxic Necrosis of the Jaws following Antiluetic Treatment. *W. Schulze.* Original in Mitt. Grenzgeb., 1918, Vol. 30, p. 366. Following is a translation of the abstract in Therap. Monatsh., May, 1919, 33, No. 5, 199. — Report of five cases of necrosis of the jaw, four of which had lues. In all the cases, sequestra were formed (in one, of nearly the entire lower jaw) following severe, purulent inflammation of the buccal and alveolar mucous membrane. Healing occurred eventually in spite of their severity. In one case, the condition was directly attributable to the injection of arsenious acid by a dentist into the tissue surrounding an alveolus. In the remaining three cases, the writer believes that mercury was largely responsible for the lesions. In one of these cases he believes that tertiary lues was partly responsible. Of the preparations of mercury, he believes that one called mercinol is particularly apt to be injurious because it is rather insoluble and causes marked irritation of the buccal mucous membrane. The writer warns against the use of too large doses of insoluble mercury salts. — G. B. Wislocki.

Identification and Quantitative Determination of Small Amounts of Hydrocyanic Acid. *P. Lavialle* and *L. Varenne.* Apoth. Ztg., 1919, p. 116, from Journ. d. Pharm. et de Chir. Following is a translation of the abstract in Therap. Monatsh., June, 1919, 33, No. 6, 238. — Cyanides when treated with calcium polysulphide are converted quantitatively into rhodanides, in case there are no ammonium compounds present. The determinations reported here are based on this fact. The rhodanides are titrated with silver nitrate. — G. B. Wislocki.

Experiments on Detoxifying Inhaled Hydrocyanic Acid by Sodium Thiosulphate. *E. Teichmann* and *W. Nagel.* Biochem. Zschr., 1919, 93, p. 312. Following is a translation of the abstract in Therap. Monatsh., July, 1919, 33, No. 7, 278. — These investigators poisoned mice in glass cages with fumes of hydrocyanic acid of 0.1 per cent. concentration, the animals dying in $2\frac{1}{2}$–$6\frac{1}{2}$ minutes. They then attempted to save the animals by the intraperitoneal injection of 3 mg. of sodium thiosulphate per gram of body weight, 3–5 minutes after gassing. Of fourteen untreated mice, nine died; of twelve treated ones, five died. The injection of sodium thiosulphate is consequently considered far less effective in saving mice that have been gassed than in saving those that have been injected with hydrocyanic acid, the favorable treatment of which with thiosulphate was reported by Lang. The treatment with thiosulphate was found more effective in animals which had been gassed with sublethal concentrations of hydrocyanic acid. Treatment with thiosulphate previous to gassing was very effective and the writers consider this of practical importance and recommend that persons working with hydrocyanic acid be previously treated with thiosulphate. — G. B. Wislocki.

Chrome Poisoning: Interesting Cases from Toxicological Practice. *W. Lührig.* Original in Mitteilung a. d. Chem. Unters.-Amt d. Stadt Breslau, Pharm. Zentr. Halle, 1919, p. 165. Following is a translation of the abstract in Therap. Monatsh., June, 1919, 33, No. 6, 239. — The writer reports cases of poisoning by chromates, caused by mistaking potassium chromate for sulphur in the preparation of a sulphur ointment to be used in the treatment of scabies. The patients were consequently treated with a vaseline salve containing 37 per cent. potassium chromate. Several of the cases had a fatal outcome.

The writer gives several methods for the quantitative identification of traces of chrome in the organs obtained at autopsy. The tissues of four persons were examined. One-third to one-fourth of the entire amount of poison was recovered from the brain, and of the other organs it was found in large amounts in the liver and kidneys. — G. B. Wislocki.

Poisoning by Dinitrobenzol. *O. Steiner.* Original in Schweiz. KorrBl., 1919, p. 1139. Following is a translation of the abstract in Therap. Monatsh., July, 1919, 33, No. 7, 279. — The cases reported are in munitions workers. The mild cases are characterized by bluish discoloration of the skin, general malaise and headache; the severe cases, by loss of consciousness, dyspnea, fibrillary muscle twitching and pronounced odor of HCN. Therapy: inhalation of oxygen, baths and stimulants. No deaths occurred. — G. B. Wislocki.

Poisoning by Oil of Chenopodium. *P. Ryhiner.* Original in Schweiz. KorrBl., 1919, p. 161 and 360. Following is a translation of the abstract in Therap. Monatsh., July, 1919, 33, No. 7, 279. — The writer presents a number of case histories which show that oleum chenopodii is an excellent remedy in ascaris infections but that it cannot be used in indiscriminate doses. In addition to Ryhiner's cases there are fifteen others of poisoning by oil of chenopodium, ten of which terminated fatally. In severe cases, hearing may remain permanently impaired but the other cranial nerves escape injury. The dose for adults should be 16 drops three times daily; for children, 8 drops three times every other day. Ryhiner observed poisoning even with this dose, so he advises giving children 1 drop hourly until the

total is the same as their age. Two hours after the last dose he gives a laxative. — G. B. Wislocki.

Heart Findings in Illuminating Gas Poisoning. *Herman Zondek.* Deutsch. med. Wchnschr., June 19, 1919, 45, No. 25, 678–680. — "In illuminating gas poisoning a constant symptom-complex is seen in the heart and circulatory system. It shows itself:

"1. In a pronounced fall in blood-pressure, lasting about a week.

"2. In early tachycardia, which gives place on the third or fourth day to a slowing of the pulse. Irregularity of the beat, in the sense of extrasystoles or marked sinus arrythmia, will be noted.

"3. In an acute dilatation of the heart, which may reach a very serious degree. In strong, functionally powerful hearts, this confines itself to a decrease of tone; in functionally less efficient hearts, a myogenous dilatation follows the lessened force of contraction and loss of elastic recoil. This usually disappears on the third or fourth day following the poisoning, but in some cases occurs first on the third day, as the so-called delayed dilatation. Thus, the degree of enlargement of the heart is an index of its efficiency and resistance." — T. J. Putnam.

Contribution to the Study of Lead Intoxication Occurring among Painters. *M. Herman.* Bull. Acad. Méd. Belg., July, 1914, 4th series, 28, No. 7, 484–489, and Scalpel, August 10, 1919, 72, No. 14, 320–325. Dr. Herman has started experiments on the vexed question of vapors or particles emitted by lead paint.

1. A piece of filter-paper is hung above a fresh mixture of white lead and oil; the whole is covered with a bell-glass. After twenty-four hours, the filter-paper gives with H_2S the reaction of lead. But if the mixture of white of lead and oil is left to stand two days before the filter is hung above it, no lead is found in the filter-paper.

Conclusion: Lead vapors or particles are emitted from fresh lead paint; this emission ceases completely after forty-eight hours.

2. In a room (16 feet long, 13 feet broad, 17 feet high), a workman paints the four walls from the floor to a line situated 5 feet high. A sheet of filter-paper is wound round the head, neck and chest of the painter, who is under strict supervision in order to prevent him from touching the filter-paper with his fingers or brush. After two hours the work is finished, and on the paper three drops are plainly visible. The paper is left to stand for twenty-four hours over an osmic acid solution; forty-nine paint-drops become visible, and this number is considerably increased if the paper is examined with a magnifying glass.

Conclusion: Painting a room emits a considerable number of very minute invisible paint droplets.

3. Four men paint the whole of the room. Twenty pieces of paper are hung for twenty-four hours at different heights and in different parts of the room. The papers hung in the upper part of the room do not give the reaction of lead; the others do at an increasing rate when nearing the floor.

Conclusion: The lead emission from a painted surface tends downwards.

4. The room is painted again, and the air aspired through the keyhole passes in a glass tube containing two cotton-wool stoppers; then the air bubbles through diluted H_2SO_4. After twenty-eight hours, the first stopper gives the reaction of lead; the second stopper and the H_2SO_4 do not.

Conclusion: The lead emission from a painted surface consists of particles, not vapors.

5. Atmospheric air is aspired through a series of three bottles: the first is half filled with water; the second (capacity 25 pints) has been internally painted, two hours before the experiment started, with white of lead and oil; the third bottle is half filled with diluted H_2SO_4. After ninety-six hours, the H_2SO_4 in the third bottle gives the reaction of lead. But if a cotton-wool stopper is put between the second and the third bottle, the stopper gives the reaction of lead, and the H_2SO_4 does not.

Conclusion: Two hours after the completion of work, a painted surface still emits very small droplets or particles containing lead, but no lead vapors. — René Sand.

The Early Diagnosis of Industrial Lead Poisoning by Means of Blood Tests. *Schnitter.* Deutsch. med. Wchnschr., June 26, 1919, 45, No. 26, 711–712. The author remarks that the impending socialization of industry will demand three general measures in regard to workers in lead: the adoption of all possible safety measures, the elimination of especially susceptible workers, and the medical supervision of all employees. Supervision, he believes, will be most efficiently accomplished by means of periodical blood examinations. A worker showing more than 100 stippled cells per million should not be permitted to work with lead, and one with more than 500 per million should be considered definitely sick. The author reports that none of his cases of lead poisoning were free from stippled cells, the reason that they have been overlooked by other workers is that fine stippling is obscured by the counterstain. He recommends staining with azure of Manson's methylene blue alone, in searching for them. — T. J. Putnam.

DUST HAZARDS AND THEIR EFFECTS

Health Risks from Dust Caused by Buffing, Polishing, and Grinding Metals. *John Roach.* Safety Engin., May, 1919, 37, No. 5, 236–243. — The circumstances affecting the metal buffer and polisher's health and mortality caused the New Jersey Legislature in 1914 to enact a law authorizing the Department of Labor to compel the installation of exhaust systems in plants where buffing, polishing and grinding wheels were operated. The serious character of the health risk of workers employed in buffing and polishing metal goods may be understood from a study of statistics made in Newark, N. J., in which the statement is made that the death rate from tuberculosis in 1914 was 50 in 1000, and that after the dust removal systems had been in operation nine years, the death rate had been reduced to 6 deaths in 1000. In 1912, the New Jersey Department of Labor also made an exhaustive examination into the engineering principles involved in the control of industrial dusts, and, as a consequence, the specifications given in this article were prepared covering buffing, polishing and grinding wheels. A buffing and polishing room equipped with a blower system constructed in accordance with the New Jersey standards offers no health risks to the workers employed therein. — R. Thomson.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Influenza Studies. I. On Certain General Statistical Aspects of the 1918 Epidemic in American Cities. *Raymond Pearl.* U. S. Pub. Health Ser., Pub. Health Rep., August 8, 1919, 34, No. 32, 1743–1783. — In this study the weekly mortality statistics of the influenza epidemic were analyzed for thirty-nine American cities. An extraordinary degree of variation was found among the several cities, in respect to the relative degree of explosiveness of the outbreak of epidemic mortality. An analysis of this variation by multiple correlation demonstrated that an important factor in its cause was the magnitude of the normal death rates observed in the same communities, particularly those death rates from pulmonary tuberculosis, and from diseases of the heart and of the kidneys. — K. R. Drinker.

Statements by the United States Public Health Service Relative to a Possible Recurrence of the Influenza Epidemic During the Fall or Winter. U. S. Pub. Health Ser., Pub. Health Rep., September 19, 1919, 34, No. 38, 2105–2110. — K. R. Drinker.

New Tuberculosis Directories. U. S. Pub. Health Ser., Pub. Health Rep., October 3, 1919, 34, No. 40, 2189. — The National Tuberculosis Association announces the publication of a new edition of its tuberculosis directories. The address of the Association is 384 Fourth Avenue, New York City. — L. A. Shaw.

The Malaria Problem of the South. *H. R. Carter.* U. S. Pub. Health Ser., Pub. Health Rep., August 22, 1919, 34, No. 34, 1927–1935. — In many sections of the South malaria constitutes little or no problem at all; but in those sections where it is really prevalent, the question of malaria constitutes the most important sanitary problem with which we have to deal. Though malaria does not give a high mortality, an infected man may be half sick all the time, and his efficiency as a workman thus reduced very seriously. Prevalence of malaria has been known to cause prospective industrial development in certain localities to be abandoned completely. This disease has been slighted in the past by health officers for two reasons: (1) The progressive local health officers of the South are those of the city; (2) malaria in certain localities is looked upon as an accepted and unavoidable fact, from which immunity can only be acquired by a certain period of ill health.

The remainder of the article deals with the areas of prevalence, the mode of malaria conveyance, and the methods of malaria control. — L. A. Shaw.

July Report of the Division of Venereal Diseases, United States Public Health Service. U. S. Pub. Health Ser., Pub. Health Rep., September 5, 1919, 34, No. 36, 2019–2022. — This report consists of a table covering the activities of 131 clinics operated under the joint control of the United States Public Health Service and the state Boards of Health during July, 1919. During this month 5,624 new cases of venereal disease were admitted, making a total of 16,871 persons under treatment. — K. R. Drinker.

Plan Proposed by the United States Public Health Service for Combating Venereal Disease in Industry. Division of Venereal Disease, U. S. Pub. Health Ser. — The following is an outline of the plan proposed by the U. S. Public Health Service for combating venereal diseases in industry:

1. Distribution of educational pamphlets, posting of bulletins, placards, etc. These may be obtained on request from the U. S. Public Health Service, 228 First St., N. W., Washington, D. C.

2. Confidential interviews between employees and executive entrusted with execution of plan.

Free lectures by federal and state health officers who will visit plant upon request.

3. Examination by competent doctors of employees who have or think they have a venereal disease. If feasible, time off with pay should be allowed where gonorrhea or syphilis is in infectious stage. Utilizing of existing medical or welfare organization in plant to include venereal disease control work and investigation by proper person into family condition of infected married workers.

4. Disposition of cases for treatment either by individual physician at hospital or plant clinic, with conscientious follow-up work. Clinics operated by U. S. Public Health Service, state or local Boards of Health are now available in many communities. Ascertain if your community has one, and use it. A complete list of the locations and addresses of these clinics may be had on request.

5. Physical examinations of patients for a reasonable time after they are pronounced cured of gonorrhea. Few cases of syphilis can be cured in less than several years' time, but they will *cease to be infectious and dangerous to others* as soon as all open sores have been healed, which will require usually only a few months.

6. Realization on part of citizens generally that, for purposes of protecting the public health, *venereal diseases are diseases — not crimes necessarily.* — K. R. Drinker.

The Department of Health's Venereal Disease Advisory Service. Weekly Bull., N. Y. City Dept. Health., October 25, 1919, 8, No. 43, 337–339. — The function of the Venereal Disease Advisory Clinics of the Bureau of Preventable Diseases is primarily to combat the advertising quack, the patent medicine agencies, and other irregular methods of cure. All those in need of authoritative and medical advice are counseled to visit this new clinic, with the result that several thousand individuals are advised annually. — L. A. Shaw.

Venereal Disease Control Activities. *C. V. Herdliska.* U. S. Pub. Health Ser., Pub. Health Rep., October 10, 1919, 34, No. 41, 2241–2247. — A report of the activities of the Division of Venereal Diseases of the Public Health Service during the fiscal year ending June 30, 1919. This campaign was conducted through physicians, dentists, druggists, nurses, medical and allied colleges, professional journals and advertising media throughout the country. — L. A. Shaw.

Druggists Enlist in Fight against Venereal Diseases. Ohio Pub. Health Jour., June, 1919, 10, No. 6, 221–222. — The state Department of Health of Ohio announces that 562 druggists of the state have entered into an agreement by which they will cease selling patent medicines for treatment of venereal diseases and will give full co-operation in the eradication of these infections. — L. A. Shaw.

Publicity Aids Venereal Disease Fight. *J. M. Shapiro.* Ohio Pub. Health Jour., June, 1919, 10, No. 6, 224. — Instances of the value of newspaper publicity and lectures in the control of venereal diseases. — L. A. Shaw.

Certain Features of the Education and Publicity Campaign for the Control of Venereal Diseases in New Jersey with Some Apparent Results. *J. H. Smith, Jr.* New Jersey State Dept. of Health, Pub. Health News, September, 1919, 4, No. 10, 259–263. — The success of the campaign against venereal diseases throughout the state of New Jersey, conducted through the medium of billboards, street cars, moving picture houses, etc., may be registered by the growing interest of the medical profession and by the steady increase of cases submitting themselves for examination. — L. A. Shaw.

Bureau of Venereal Disease. Bull. Wisconsin State Board of Health, April–June, 1919, 3, No. 6, 9–10. — Wisconsin has declared all venereal diseases as communicable and requires, therefore, that they be reported to the state Board of Health. Whenever a case is found on premises where it cannot be properly isolated or controlled, and when the infected person refuses to be subjected to the necessary treatment, a placard is posted on the premises: "Venereal Disease Here." Nor can such a person leave the premises without the permission of the health officer. No person afflicted with venereal disease is allowed to work in any occupation capable of transmitting the infection to other persons. — L. A. Shaw.

Value of Venereal Disease Case Reports. U. S. Pub. Health Ser., Pub. Health Rep., October 17, 1919, 34, No. 42, 2294–2297. — Adequate statistics regarding venereal diseases have been made available by the army medical examinations. Information thus obtained during the war must now come from other sources, namely, the physician in charge. Fear of offending his patient, obstinacy, and indifference have elicited objections on the part of the physician in fulfilling his prescribed duty. When the preservation of public health is at stake, however, such objections must be overridden. — L. A. Shaw.

The Diagnostic Value of the Wassermann Test. National Health Insurance, Medical Research Committee, London, H. M. Stationery Office, 1918, 54 pp. — A detailed statistical study of the value of the complement-fixation test for syphilis, in the hands of several skilled serologists. The conclusions drawn are distinctly in favor of the diagnostic value of the test. — T. J. Putnam.

The Laboratory Diagnosis of Gonococcal Infections, and Methods for the Detection of Spirochetes. National Health Insurance, Medical Research Committee, London, H. M. Stationery Office, 1918, 49 pp., colored plates. — An exhaustive report upon the technique of the various laboratory methods, and their fields of usefulness. Jen-

sen's modification of Gram's staining method for gonococci is recommended, and elaborate directions are given for obtaining uniform, accurate results. The wider use of the focal gonococcal reaction, and especially of the complement-fixation test is suggested, and instructions are given for each.

The report on methods of demonstrating spirochetes is largely taken up with a consideration of methods for adapting ordinary microscopes to dark-field work, which is much preferred to all other procedures for detecting organisms which are difficult to stain. — T. J. Putnam.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

The Injurious Effects of Oils and Vaselines on the Skin. *Prof. Bettmann.* Original in M. m. W., 1918, p. 1344. Following is a translation of the abstract in Therap. Monatsh., March, 1919, 33, No. 3, 117–118. — The writer has observed four types of injurious effects produced on the skin by various oils and vaselines used in the industries. He believes that the effects of these substances are due to the presence in them of irritating tar products. It is important to make a differential diagnosis between these conditions and other recognized diseases of the skin.

The four types of lesions observed by Bettmann are:

1. A sluggish, often itching folliculitis (differential diagnosis: tuberculosis).
2. Follicular keratosis (differential diagnosis: pityriasis rubra pilaris, psoriasis, Darier's disease).
3. Melanoderma of exposed skin surfaces (differential diagnosis: Addison's disease, arsenic melanosis, pigmentation after lichen ruber planus).
4. Circumscribed, warty areas (differential diagnosis: lupus erythematosus).

Not infrequently two or more of these types are seen in the same patient and this aids materially in the differential diagnosis. Predisposing factors are previous skin disease, exposure to heat and light, etc. The conditions are chronic and very resistant to treatment. — G. B. Wislocki.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Experience in Accident Prevention Work. *H. P. Heyne.* Safety Engin., May, 1919, 37, No. 5, 252–255. — A safety campaign inaugurated by the United Alloy Steel Corporation, Canton, Ohio, August 1, 1917, has resulted in a reduction of 54.9 per cent. in the days lost due to injuries in 1918, over that for 1917. Tables showing days lost by departments in 1918, injuries based on length of service, and injuries based on occupations are given in the article. Every foreman is a member of the safety organization, and the appointing of workmen's safety committees has made the employees feel that they are being consulted in regard to the guarding and eliminating of unsafe practices and procedures. — R. Thomson.

Reducing Accident Risks. Factory, October, 1919, 23, No. 4, 980–988. — Among the brief articles under this head may be noted Selling Safety to Employees, Getting the Foreigner to Read, Keeping Hazards in Mind. The first article calls attention to the necessity for preparing for a safety campaign by studying carefully the attitudes of the various people concerned in safety toward the movement and toward one another. This will determine the exact procedure of the safety engineer. In no case can he expect to do all the work himself. He should have salesmen in all departments who can be drawn together through some sort of safety organization.

One plant has followed the plan of having local representatives of each foreign group translate into their own languages all safety notices.

The Hood Rubber Company has adopted a scheme for keeping hazards in the minds of their workmen. When any piece of equipment is discovered to be unsafe, a red ticket is placed upon it until changes or repairs are made. — C. H. Paull.

The Library's Part in the Reduction of Industrial Accidents. *Estelle L. Liebmann.* Safety Engin., July, 1919, 38, No. 1, 25–27. — Libraries of every description, whether public or private, can be of the greatest value in the problem of accident prevention. There are about 2500 special safety engineers in this country and between 40,000 and 50,000 people whose duties are partly connected with safety. There are only four libraries in the United States that have made accident prevention their speciality. The greater part of the literature is to be found in pamphlets, documents and periodicals. The most valuable government documents are those of the Bureau of Labor Statistics in Washington. For the engineer and technical man the safety specifications published by the United States Steel Corporation, the Shipping Board and the DuPont Company rank highest. The Bureau of Standards will eventually issue safety standards. These are at present in a tentative stage and it may be a few years before the final draft is adopted. — R. Thomson.

Training Courses in Safety and Hygiene in Building Trades. Federal Board for Vocational Education, May, 1919, Bulletin No. 31, pp. 126. — This bulletin has been prepared to form the basis of instructions in safety and hygiene as applied to the building trades and is intended primarily for use in vocational schools. It consists of two parts. The first portion dealing with the proper and safe con-

duct of work in the building trades is made up of nine chapters, the more important of which deal with the questions of demolition, hoisting, scaffolding, accidents in allied trades and emergency provisions. When one realizes that industrial accidents are caused in a great many instances by the lack of attention to matters which are small and may seem trivial, the value of this pamphlet becomes apparent, for here each of these important details receives due attention. A series of excellent photographs accompanies the text. The second portion of the book occupying some ten pages is devoted to suggestions to teachers in vocational schools. A brief bibliography closes the volume. — L. Greenburg.

Methods of Securing Attendance at Railroad Safety Meetings. *Marcus A. Dow.* Safety Engin., June, 1919, 37, No. 6, 289–291. — The three things that the General Safety Agent of the New York Central Lines has found most essential to the success of safety rallies are: (*a*) a good program; (*b*) effective advertising; (*c*) co-operation of officials. A meeting where men are not bored by a dry program but are assured of one that runs according to schedule with something of interest throughout, a short but intensive advertising campaign, and a short, concise meeting generally, put enthusiasm into the whole proceedings and make attendance irresistible. The co-operation of the officers is just as important in getting a crowd to a safety rally as it is to any other feature of safety work. This spirit of official co-operation has been developed in the New York Central Lines to a degree that would in itself insure successful attendance. — R. Thomson.

Safety to Life in Retail Stores and Schools. Report of the Committee on Safety to Life, National Fire Protection Association. Safety Engin., August, 1919, 38, No. 2, 71–81. — The report of the committee, wholly tentative, is in two sections, one relating to Safety to Life in Retail Stores and the other, to Safety to Life in Schools. The fundamental difference between the store and the factory is the inability to control the number of persons who enter a retail store. In a factory the management, if it will, can meet the specific conditions laid down for a given building. In a retail store, however, the only limitation is the number of people that the building will hold with due regard to ability to move about and be waited on. The committee in devising a plan of establishing the number of occupants that may use retail store buildings has in mind the following fundamental principles:

1. To forbid the use of signally dangerous building for retail store purposes.
2. To encourage the improvement of existing buildings not up to a reasonable standard of safety.
3. To give due recognition to essential life-safety factors such as superior construction, protection of vertical openings, provision of horizontal exits, moderate heights, and provision of automatic sprinklers.
4. To encourage the best possible construction and protection for new retail store buildings.

The committee expects to put its conclusions and recommendations in specific form and to arrange its credits for various features listed above into a tabulation such as the one which is part of the factory egress code. There follow sections discussing construction, area, emptying-time factor, stair and elevator requirements, and specific egress features.

A skeleton report submitted indicates the lines along which the problems of Safety to Life in School are being attacked and it will be observed that the general outline follows as closely as may be the plan already adopted in the case of factory buildings. — R. Thomson.

Safety Education in the Schools. Am. Industries, October, 1919, 20, No. 3, 11–12. — A portion of an address given by Mr. Whitney of the National Safety Council in which he calls attention to the possibility of laying the basis for safety education in the public schools. Attention is called to the success of Dr. Payne of St. Louis in developing safety education for children. — C. H. Paull.

Teaching Safety in the Schools. *E. George Payne.* Safety Engin., June, 1919, 37, No. 6, 302–306. — By the introduction of instruction in accident prevention in the public schools of St. Louis, it was found that interest in the subject taught was intensified and the desired result achieved in a knowledge and appreciation of accident prevention. The procedure was along three lines: first, schoolroom instruction; second, dramatization; and third, the organization of the school into a welfare community for the purposes of safety. The results of this instruction have made children conscious of accidents as a matter of real social concern, and have enabled them to take an intelligent instead of an ignorant attitude toward accidents and accident prevention. The pupils themselves have established habits of carefulness that tend to prevent accidents, and they have been stimulated to greater endeavor in the regular school course, in that the subject of accident prevention provides for the effective use of the mother tongue, correct reading, etc. Finally, instruction in accident prevention has brought the child into contact with life situations, institutions and processes. — R. Thomson.

Fighting Fires Before They Start. Factory, Oct., 1919, 23, No. 4, 779–782. — This is a series of short comments drawn from experience, on procedures and devices for preventing serious fires. Among the valuable suggestions offered is a plan for drill in coupling hose inaugurated in the plant of the Ohio Brass Company. Several devices for calling attention to the location of fire alarm boxes and small fire-fighting equipment are suggested. The underlying idea of all of these is to place directions or indicators in such places that they cannot be hidden by any form of obstruction, and that they can be seen plainly from all directions.

An interesting fire-drill plan of a superintendent of a factory in the Middle West is described. This superintendent has a red flag which from time to time he places in different parts of his yard. Employees are instructed that upon seeing this flag they are to turn in an alarm at the nearest box. When once the alarm is sounded, a competition between the various fire companies of the plant begins. The company first getting a stream of water on the flag is the winner. — C. H. Paull.

Water Departments and Private Fire Lines. *Dow R. Gwinn.* Am. Arch., September 24, 1919, 116, No. 2283, 335–337. Fire protection of a general character is provided by the municipality. Where further protection of a special nature is desired, it may be obtained by independent equipment or by special connections with mains. The latter case entails a great many questions as to compensation, equipment, inspection, guarantees and so forth. Regulations governing the relations between the water department and the individual are suggested and illustrated with excerpts from court decisions. The chief points of the article may be summarized as follows:

1. Special compensation above the cost of water used shall be provided.
2. The water company or department shall install all service pipes.
3. No interconnection of the city supply with an independent supply shall be permitted.
4. No guarantee to extinguish fires or to protect property shall be given. G. M. Fair.

Chemical Fire Hazards. *W. D. Milne.* Jour. Indust. and Engin. Chem., July, 1919, 11, No. 7, 701. — The author reports that a sulphur black dye stored in a barrel was found to have caught fire spontaneously. The manufacturers claimed that too much sulphur, which was present, was responsible. — Worth Hale.

Grain Dust Explosions and Fires. *David J. Price.* Safety Engin., June, 1919, 37, No. 6, 296–300. — Between March, 1916, and October, 1917, dust explosions caused the destruction of four of the largest grain and cereal plants in the United States and Canada. In six of the largest explosions and fires in 1916 and 1917, thirty-nine persons were killed, sixty injured, 2,500,000 bushels of grain lost and property worth $8,000,000 destroyed. A campaign was conducted by the Department of Agriculture in a direct appeal to the workmen by a system of pledge cards on which a number of simple causes in control of the workmen were outlined. By moving pictures and slides, and through the hearty co-operation on the part of the grain and milling companies throughout the country, it has been possible, according to a leading grain journal in an issue in January of this year, to record a decrease of 30 per cent. — R. Thomson.

The Chlorates. *F. M. Griswold.* Safety Engin., June, 1919, 37, No. 6, 291–295. In a brief review of the fire and explosive hazards of the chemical compounds which are classed as chlorates, the most common of which are chlorates of potassium, sodium, and strontium, the author calls attention to the necessity of taking some restrictive measure to insure proper storage, handling and use. While the Explosive Law framed by Congress in October, 1917, had as its prime motive the prevention of disloyal persons from procuring explosives or their ingredients, it is probable that its enforcement as an emergency measure will become somewhat of a dead letter. An effort should be made to secure safety in the matter by suitable restrictions along the lines suggested by Chief Inspector of Explosives, Major Cooper-Key of England, which are as follows:

1. The elimination, so far as may be possible, of combustible material in packages containing chlorate.
2. The establishment of separate buildings, of fireproof construction, for the storage of chlorate.
3. Absolute cleanliness; i.e., the outside of kegs, the floor and walls of the store should be kept clean of all dust and dirt and no one should enter the building in his ordinary shoes. Either these should be taken off or overshoes should be provided, as in a gunpowder magazine.

To these regulations should be added the further precaution of prohibiting the storage of chlorates in such locations and under such conditions that they may not by any possibility of accident or design be brought into contact with other substances known to be incompatible with them. R. Thomson.

Lacquers, Shellacs, Enamels and Japans. Tentative Safety Standards Prepared by the State of New Jersey. Safety Engin., July, 1919, 38, No. 1, 15–23. — The rules herein given apply to all establishments using lacquers, shellacs, enamels and japans either by spraying, hand brushing or dipping methods except where not more than 2 quarts of material, inclusive of stock and thinner, are used per day in the hand brush or air brush process. The location, construction, ventilation, lighting, heating and cleaning of rooms where hand brush or dip tank processes are carried on are fully covered in this article, together with the storage, fire protection, and general requirements of such establishments. — R. Thomson.

INDUSTRIAL SURGERY

The Technique of Heliotherapy. *A. Aimes.* Presse méd., July 7, 1919, 38, 525. — Heliotherapy should be prescribed in definite doses, and thoroughly supervised by the doctor in charge. For general infections, such as tuberculosis, practically the whole body should be exposed. The period and extent of exposure should be graduated, beginning with fifteen minutes three times a day upon the legs and forearms. The patient should recline in the open, and should receive the full rays of the sun, unprotected by glass or partial shade. The head, however, and other parts of the body as indicated, should be shaded by awnings or light coverings. Strong winds, or temperatures below 20° or above 50° C. are contra-indications to the treatment. The exposure should always be suspended for half an hour before and after meals. For wounds, the treatment may be regional or local merely. The wound may be protected from flies by netting, or better by the evaporation of volatile oils in the vicinity. It should be carefully cleaned before each exposure. — T. J. Putnam.

A Contribution to the Study of "Stiff and Painful Shoulder." *A. J. Brown.* Surg. Gynec. and Obst., October, 1919, 29, No. 4, 381–386. — In an excellent article on this subject, Brown shows how to distinguish and treat a class of cases that has not been differentiated before. These cases have a rupture of fibers of the insertion of the latissimus dorsi and teres major muscles. The special diagnostic points are: (*a*) pain on stretching these muscles; (*b*) distinct point of tenderness over site of injury in the tendon; (*c*) early development of moderate atrophy of the deltoid muscle by involvement of the circumflex nerve in the inflammatory or reparative processes. The author outlines a conservative method of treatment for these cases. — C. C. Lund.

Endoprotheses of Reinforced Rubber for Losses of Skeletal Bone. *Delbet, Girode* and *Contremoulin.* Presse méd., July 31, 1919, 42, 536. — The authors describe two cases in which loss of substance of the radius had been replaced by rubber-covered metal protheses, with good results. Sheets of rubber have also been used for reconstructing tendons, protecting nerves, and for guarding the abdominal wall against hernia. — T. J. Putnam.

Primary Suture of Gunshot Wounds. *S. F. Koch.* Surg. Gynec. and Obst., October, 1919, 29, No. 4, 362–373. — The author describes his methods of treating war wounds and discusses the application of these methods to civil surgery. — C. C. Lund.

Injury Due to Indelible Pencil. *Sigmund Erdheim.* Wien. klin. Wchnschr., July 3, 1919, 32, No. 27, 726.—A report to the Vienna Medical Society of a case in which the point of a violet copy pencil was forced into the palm of the hand. The small wound did not heal but developed into a fistulous ulcer. There was no pus, only a slightly cloudy serous, violet fluid appeared. The cause of the slow healing is the necrotizing action of the poison for all tissues. The dye, methyl violet, in the copying pencil dissolves in the tissue fluids and travels deeper and deeper, thus enlarging the necrotic area. Prompt excision of the offending pencil point with surrounding tissue is the best procedure for inducing quick healing. — B. Cohen.

FATIGUE AND OCCUPATIONAL NEUROSES

Early Closing Helps Efficiency of Workers. *May L. Manning.* The National Civic Federation Review, July 30, 1919, 4, No. 17, 9, 19. — G. E. Partridge.

An Investigation of Changes in the Blood and Urine Resulting from Fatigue. *A. B. Hastings.* U. S. Pub. Health Ser., Pub. Health Rep., August 1, 1919, 34, No. 31, 1682–1691. — The attention of the writer has been centered on the hydrogen-ion concentration of the urine and blood plasma, and the alkaline reserve of the latter as modified by muscular work. Studies reported were made for the most part on the urine of men and the blood of dogs. The histories and diets of the subjects investigated were carefully followed.

The types of exercise studied consisted in: (1) dogs running in a treadmill; (2) men engaged in mechanical operations of various degrees of arduousness at an automobile factory; (3) men participating in a 12-mile Marathon race; (4) entrants in a 6-day bicycle race; (4) a man in a 10-mile walk. The results of the observations are summarized as follows:

1. Exercise produced a diminution of bound carbon dioxide of the blood plasma. The depletion, however, did not progress to such a point that the reaction of the plasma was significantly altered.

2. The lowering of the bound carbon dioxide was a function of the rate and the amount of exercise.

3. The rate at which the bound carbon dioxide returned to its original value was related to the amount of exercise.

4. The urine of men engaged in manual labor tended to be of a slightly higher degree of acidity than that of men at rest. This statement could only be made of the class as a whole, and could not be reliably applied to individuals without accurate knowledge of their diets.

5. The urine of physically strong men was regularly slightly more acid after work than before; the

urine of physically weak men showed wide variations in its reactions from day to day.

6. When the muscular activity was such that the subject was intensely fatigued, there was invariably an increase in the hydrogen-ion concentration of the urine. — C. K. Drinker.

Rhythm in Industry. U. S. Pub. Health Ser., Pub. Health Rep., July 25, 1919, 34, No. 30, 1621–1622. — Rhythmical movements occurring in machine operations may prove significant in occupational fatigue. The possible importance of rhythm in industry may be fourfold:

1. In relieving attention and its consequent fatigue.

2. In rendering more uniform the metabolism and recovery involved in the operation by evenly distributing the work.

3. In masking fatigue effects.

4. In increasing or decreasing accident hazard according to the type of accident causation. — L. A. Shaw.

NUTRITION AND METABOLISM

Studies of Food and Nutrition. Am. Jour. Physiol., September, 1919, 19, No. 4. — This issue contains the following articles based upon observations in the army:

The Practicability of Feeding a Scientifically Balanced Ration in Army Corps. *R. J. Anderson.*

Average Food Consumption in the Training Camps of the United States Army. *J. R. Murlin* and *F. M. Hildebrandt.*

Variations in Strength and in the Consumption of Food by Recruits and Seasoned Troops. *P. E. Howe, C. C. Mason* and *S. C. Dinsmore.*

Note on the Acid-Base Balance of Army Rations. *N. R. Blatherwick.*

Dried Vegetables for Army Use. *S. C. Prescott.*

American Military Hospital Dietaries. *R. G. Hoskins.* P. G. Stiles.

Studies on the Influence of the Type of Diet. *E. Abderhalden.* Arch. f. d. ges. Physiol., June 17, 1919, 175, Nos. 3–6, 187–326. — A report of extended experiments upon the influence of minor constituents of the diet upon growth and condition of animals. The evidence for the existence of vitamines or nutramines, especially of the fat-soluble type, is impressive. — P. G. Stiles.

Roentgen Findings in Nutritional Skeletal Damage. *Konrad Staunig.* Wien. klin. Woch., July 3, 1919, 32, No. 27, 712. — Diseases causing skeletal damage of nutritional origin are observed to occur in some local areas as well as sporadically, and are claimed to attack females of all ages almost exclusively. The bone structure shows regressive changes. The single trabeculae of the spongiosa appear narrower and the narrow spaces correspondingly wider. The cross and oblique channels appear mostly obliterated, while the vertical ones are preserved. The bone thus appears longitudinally striated. Spontaneous fractures cause no noteworthy acceleration of skeletal atrophy. Deformations like those in osteomalacia were not found. It is concluded that the soft tissues in the bone must have lost in consistency. — B. Cohen.

WOMEN AND CHILDREN IN INDUSTRY

The Women's Reward. *Clementina Black.* The Women's Industrial News, April, 1919, 22, No. 83, 13–16. — The author implies that, while the material reward to women for their work in wartime industries has been large (but not always to the improvement of the class), the main chance for benefiting women through their work has been allowed to go by. To let these women fall back from the new level into the old unskilled and underpaid labor is stupid, cruel and wasteful. They ought to have had opened to them every opportunity for training and developing their newly-awakened faculties. A part of the surplus earnings gained in wartime ought to have been directed to this educational end. — G. E. Partridge.

Women in Transportation. Bull. N. Y. State Ind. Com., September, 1919, 4, No. 12, 237, 239. — Investigations of the employment of women in transportation companies showed need of state regulation to give women thus employed the same protection as those employed in factories and department stores. The laws enacted as a consequence of these investigations are herein discussed, with special reference to the new arrangements which the companies were compelled to make in order that women employees might be retained in conformity with the new laws. — L. A. Shaw.

The Protection of Expectant Mothers at Work During the War. *L. Bargeron.* Rev. d'hyg., April, 1919, 41, No. 4, 317–335. — In drawing up a law for the protection of expectant mothers in factories the Commission of Labor recognized that it would not do simply to forbid the employment of pregnant women in factories. This would discredit motherhood and would promote prevention of conception, abortion, etc. The law as adopted contains the following points:

1. Pregnancy gives the woman a right to lighter employment if her work is injurious to her condition.

2. Overtime and night work are prohibited.

3. The woman must be seated when working; she must stop work four weeks before term and for four weeks after labor.

4. Wages must not be reduced on account of the changes incurred by this law.

5. It is the duty of the factory physician to watch over such women.

6. Each factory must have a nursing room conducted at the expense of the factory owners.

7. All mothers who have worked more than four months in the factory must be paid full wages during the eight weeks' absence. — A. Allemann.

Children in Factory Life. *M. Skinner.* The Women's Industrial News, April, 1919, 22, No. 83, 10–13. — The Home Office has required medical examination of boys and girls between the ages of 14 and 18 on their entrance into industrial life. Statistical reports from one medical examiner for the years from 1914 to 1918 show about 7 per cent. of a total of about 20,000 applicants rejected. — G. E. Partridge.

Administration of Child Labor Laws. Part 3. Employment Certificate System, Maryland. *F. H. Bird* and *E. A. Merritt.* U. S. Dept. Labor, Children's Bureau Publication No. 41, pp. 127. — In this pamphlet the employment certificate system in Maryland is fully and comprehensively discussed. The scope of the child labor laws is clearly defined. Then follows a description of the general administration, methods of securing certificates both as to physical and mental requirements, enforcement and record keeping. The main portion of the pamphlet closes with a summary in which the following are recorded as the most important changes needed in Maryland to bring about better protection of working children:

"(1) Issuance of all certificates throughout the state under such direct supervision by the Board of Labor and Statistics as will insure the strict enforcement of the age, educational, and physical standards set by law; (2) uniformity throughout the state in school-attendance requirements for children of school age and in educational standards for leaving school; (3) co-operation between the certificate-issuing officials and the school authorities in the eastern counties; (4) appointment of a larger number of inspectors and certificate-issuing officials; (5) provisions for insuring their competency; and (6) adequate support of both the child-labor and the compulsory-education laws by all the magistrates before whom prosecutions are brought." — L. Greenburg.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Planning for a Manufacturing Plant. *Henry T. Noyes.* Ann. Am. Acad. Pol. Sc., September, 1919, 85, No. 174, 66–89. — The writer deals with the various problems of planning for a new plant as seen from the standpoint of the manufacturer. A number of the points which are discussed have to do with safety, sanitation and the hygiene of the worker. In speaking of the theory of light, the writer points out the great advantage of obtaining light direct from the sky. Buildings should run east and west wherever practicable so that as uniform a light as possible will be obtained. Among the factors which have a part in determining the most desirable width for a plant building are cost, character of work and machinery necessary, and lighting. As far as possible stairways should not cut into the regular floor space of a room. Where they can be located in a wing or tower, they furnish excellent fire escapes.

In planning for toilet rooms, consideration should always be had for the possibility of an increase in the working force at some time in the future.

Among the precautions against fire hazard which are recommended are: a sprinkler system, as fireproof construction as possible, buckets and chemical extinguishers, a double source of water supply, fireproof partitions and fire escapes.

While direct radiation is an efficient method for distributing heat it does not solve the problem of ventilation where a large number of workers are grouped in a relatively small space. Indirect radiation greatly assists ventilation, though it may not supply a necessary amount of heat in remote spots. A combination of these methods is sometimes used.

In planning a modern factory, space must be allowed for such service activities as lunch rooms, adequate rest rooms, hospital and dispensary rooms. — C. H. Paull.

Hygiene in the Reconstruction of Factories after the War. *L. Bargeron.* Ann. d'hyg., February, 1919, 31, 116–125. — Of particular danger are factories where poisonous products are handled and where explosives are manufactured. Since the use of white lead in paint work has been prohibited, the factories making hydrocarbonate of lead are much fewer, but as long as there are any at all, hygienic precautions must be observed. All factories where poisonous substances are handled should be built so that they can be washed with great streams of water. There should be a sick-room containing the necessary medicines to give first aid in cases of accidental poisoning, as well as a bathroom with douches where the workmen can take a sulphur bath at least once every two weeks. The men should receive careful instruction regarding the dangers of their work and wherever necessary should wear respiratory masks.

In the region devastated by the war, there are many sulphuric acid, nitric acid and hydrochloric acid factories where the workmen are exposed to poisonous vapors. The plans for rebuilding these factories should be made with a view to protect-

ing the health of the employees. In the establishments where hides are handled, precautions should be taken to avoid infection from anthrax by examining and disinfecting all hides received from foreign countries, especially those from South America, India and China. Workmen should wear gloves and should not be allowed to eat any meals in the factory. Tincture of iodine and nitrate of silver should always be at their disposal. — A. Allemann.

Improving Shop Efficiency by Better Lighting. *Thomas F. Chantler.* Safety Engin., August, 1919, 38, No. 2, 53–59. — The value of good lighting from the point of view of economy as well as that of safety has been recognized by leaders in different professions. It has been shown by facts and figures deducted from actual tests that good lighting actually does serve to hasten production, reduce spoilage, prevent accidents and conserve power in manufacturing and industrial lines. In addition there are what may be termed dollars-and-cents reasons why the manufacturer should do everything possible to supply his workers with the best illumination available. Good lighting has been definitely shown to contribute to the prevention of accidents and to the consequent reduction in insurance company rates for workmen's insurance. The general requirements of good illumination are given simply and briefly as follows:

1. There must be on all working surfaces, whether in horizontal, vertical, or oblique planes, a steady light of sufficient intensity for all working requirements.

2. A light on areas and walls adjacent to the working area comparable in intensity to the light on the working areas.

3. The light must be of a color and specular character suited to the purposes for which it is employed.

4. There must be freedom from glare and glaring reflections.

In this same issue of *Safety Engineering* will be found other articles relating to lighting. — R. Thomson.

What It Pays to Know about Factory Lighting: How to Regulate Your Window Light. *C. E. Clewell.* Factory, October, 1919, 23, No. 4, 776–779. — The writer points out the close relationship of properly regulated lighting and ventilation to health and absenteeism. Assuming that adequate window space has been provided, he shows how this space may be used to the best advantage only when facilities are provided for excluding excess light during certain times of the day. In using shades, care should be taken to locate them so that they will not cut off too much light from workers at a distance from the windows. In some cases shades may be advantageously located across the middle of the window; in others they are used to greatest advantage when drawn up from the bottom of the window. Each plant must study its own needs.

As far as possible workers should not be seated in such a way as to receive direct glare from window space. This difficulty can frequently be obviated by running benches at right angles to window areas.

In equipping windows with glass, the present tendency is to use transparent glass in the lower portions of all window space regardless of what is used above. The old idea that workers waste time looking out of windows is being superseded by the newer theory that it is restful for them to have a view beyond the limits of the factory, and that clear windows tend to dispel the feeling of being shut in. A series of interesting illustrations of different types of windows and window shades accompanies this article. — C. H. Paull.

Heating and Ventilating Problems. *W. Nygren.* The National Civic Federation Review, March 25, 1919, 4, No. 11, 8–9, 11. — There is a general lack of understanding of the purely commercial advantages to be gained by effective ventilation of working spaces. There is no reason why the quality of atmospheric conditions in working quarters and elsewhere should not be a matter worthy of government control, and certainly in all doubtful cases the properties of the atmosphere should be measured. The writer recommends a bureau to supervise and control all matters pertaining to ventilation. A concise analysis is given of the problem of good ventilating and heating. — G. E. Partridge.

An Automatic Regulator of Temperature. Riv. di ingegner. san., June 30, 1919, 12, No. 12, 78.

This apparatus renders it possible to maintain the temperature in a working room automatically between fixed limits. It consists essentially of a specially constructed thermometer and a small electric motor with reversible current which acts as a regulator of the cooling apparatus. The feeding of the current to the motor is controlled by a double interrupter, set in motion by the motor and by two electro-magnetic interrupters, which are under the influence of the current which is started by the thermometric column. Thus the thermometer presents two series of contacts to each of which corresponds one of the two circuits; one for the minimum, the other for the maximum. By moving the contact thorns on the graded scale, it is possible to fix the minimum and maximum limits between which the temperature is to be maintained. When the thermometric column falls and reaches the minimum contact, one of the currents is set in motion and opens the source of heat; when the column rises and reaches the maximum contact, the other current is set in motion and shuts off the source of heat. — A. Allemann.

Standards for Factory Wash Room Facilities. The National Civic Federation Review, July 30, 1919, 4, No. 17, 18–19. — A set of specifications for wash room facilities as planned by the Welfare Division of the Committee on Labor, a part of the Advisory Commission of the Council of National Defense. These standards are applicable to fac-

tories in general and "are a little better than the requirements of any state law." They include standards in regard to washing facilities, toilet arrangements and fixtures. — G. E. Partridge.

Stream Pollution and its Relation to the Chemical Industries. *Earle B. Phelps.* Jour. Indust. and Engin. Chem., October, 1919, 11, No. 10, 928–929. — The author discusses the desirability of treating factory wastes discharged into streams both from the point of view of chemical factory management and from the effect of such wastes upon the water for drinking purposes. — Worth Hale.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Keeping Workers Fit. *Albert E. Richter.* System, October, 1919, 26, No. 4, 622–626. — An intimate account of a plan developed for reducing absence through illness of an office force. Realizing that considerable money was being lost through absence due to illness, the Retail Credit Company began a careful study of the health needs of its employees. It found that a large number of its people knew little or nothing of their health condition. This led to the institution of regular physical examinations, from which grew a policy of health education. The most interesting feature of the whole procedure was the sincere attempt of the company to anticipate and prevent illness. Where necessary, vacations were given to prevent threatened breakdowns. These vacations were based upon the needs of the individuals and not primarily upon the term of employment, though a regular policy of granting yearly vacations is in operation.

Not only were the immediate facts of the physical condition of the worker studied, but where a solution of a difficulty seemed more remote, the company assisted workers in removing economic handicaps which resulted in worries not connected with actual employment. — C. H. Paull.

Our Shop Dental Dispensary. *Sanford De Hoit.* Ind. Management, July, 1919, 58, No. 1, 52–53. — A brief account of the experience of the R. K. LeBland Machine Tool Company in operating a dental dispensary. Since the establishment of the dispensary a large proportion of employees have availed themselves of this service. All work is done at company expense and on company time. The cost to the company has been $1.12 per patient treated. In return many employees have been kept on the job when otherwise they would have lost at least a half day for each visit to a dentist's office outside the plant. Besides the regular work of the dispensary, much has been accomplished along educational lines. — C. H. Paull.

INDUSTRIAL NURSING

Industrial Welfare Nursing. *Frances McGee.* Am. Jour. Nursing, Sept., 1919, 19, No. 12, 920–922. — The work of the industrial nurse is daily exceeding in scope the old established boundaries. With the ever increasing size of industrial organizations and the consequent larger number of employees, the first-aid room has assumed the dignity of a part of the main office, or, in some cases, of a separate building. Accurate records have become essential. To be of the greatest service, the industrial nurse must have the social spirit; she must be sympathetic so that it will be the tendency of the men to return for treatment; she must gain the confidence of her patients so that information may be obtained and advice offered. — L. A. Shaw.

INDUSTRIAL, PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Housing, Democracy's Balance Wheel. *W. H. Ham.* The National Civic Federation Review, March 5, 1919, 4, No. 10, 1–6, 18. — This is an interesting account with illustrations of the housing work that has been done in Bridgeport. The writer thinks that now is the time to take a long look ahead and to devise methods of financing the housing of the industrial classes upon a basis that will become standard and more or less automatic; and, at the same time, we must consider carefully proper "zoning" of our cities and all the problems of expansion that have hitherto been neglected. Continuity of plan and permanency of results must be considered. The paper is suggestive, but does not offer many definite conclusions. — G. E. Partridge.

Bad Housing and Ill Health. *James Ford.* U. S. Bur. Labor Statis., Month. Labor Rev., July, 1919, 9, No. 1, 243–248. — Among the bad results of poor housing conditions are heavy increase in labor turnover, poor health leading to inefficiency, and growing discontent as a social evil. Of various types of houses mentioned, the writer points out the multiple house as the most unsatisfactory under usual conditions. The rest of his remarks deal primarily with the undesirable features of this type of dwelling. Among these features are danger from fire due to cheap construction, accident risk due to depreciation of cheap construction, defective orientation with reference to the points of the compass and neighboring buildings, health hazards due to excessive stair climbing in high dwellings, improper

lighting, sanitation, ventilation, overcrowding within dwellings and within areas where the multiple dwelling is common, and proximity to factories. — C. H. Paull.

Housing and Health. *J. H. McBride.* Public Health, Mich. Dept. Health, October, 1919, 6, No. 10, 439–451. — One of the chief causes of physical and moral degeneracy is to be found in the condition of the houses in which men live. Sickness, crime, drunkenness, insanity and high infant mortality rates occur where the housing conditions are worst. The effects of bad housing are not confined to the cities alone; they prevail in villages and on farms. Sickness is found to be in direct proportion to overcrowding; given the room space and size of families, an approximate estimate of the death rate may be given.

It is the business of the community to prevent any landlord from maintaining that which is a menace to the health of the neighborhood. It is the inhabitants of such disease-breeding hovels who spread infection, both directly through contact, and indirectly through the product of their industry. Furthermore, the working capacity and economic value of the individual are reduced by bad conditions of home life. The interest and animal vigor necessary for good work do not thrive in forbidding surroundings or in squalid quarters. — L. A. Shaw.

The Report of the United States Housing Corporation. Am. Arch., September 24, 1919, 116, No. 2283, 399–408, 411–414. — This is an extensive review of the *Report of the United States Housing Corporation*, a cloth-bound book of more than 500 pages, which treats of the housing of war workers undertaken by the Bureau of Industrial Housing and Transportation of the Department of Labor. The report deals with every phase of the question of industrial housing and gives more than 250 illustrations of typical examples in approximately forty-five different localities. The review is well illustrated and quotes at length from the report. — G. M. Fair.

Canada's Post-War Housing Progress. Conservation of Life, Commission of Conservation, Canada, July, 1919, 5, No. 13, 50–56. — The building of houses is incidental to the development of industry. One of the first necessities to obtain efficiency is the improvement of housing conditions. In fact, necessity rather than far-sightedness is the paramount cause of action. A housing scheme has been passed upon by the Dominion and Provincial governments for general application throughout the whole Dominion. The character of this housing scheme is herein outlined. — L. A. Shaw.

Housing Development as a Post-War Problem in Canada. *Thomas Adams.* U. S. Bur. Labor Statis., Month. Labor Rev., July, 1919, 9, No. 1, 248–254. — The writer points out some of the chief characteristics of the Canadian national housing project. This project provides for a loan fund of $25,000,000 to be distributed among the provinces pro rata to the population. Because of the provisions of the constitution of Canada the administering of this fund is left to the provinces and municipalities. The federal government has the responsibility of approving general schemes for each province and establishing standards. The provinces must eventually repay the loan to the federal government and administer the general scheme to the municipalities. The responsibility for repaying the loan to the province rests with the municipality, and this agency must also supervise the administration of the project to individuals. Since the adoption of the federal scheme most of the provinces have passed acts to take advantage of the loan. In general, the federal government is not attempting to establish exact standards, but wishes rather to establish such standards as are apt to be overlooked by the municipalities. — C. H. Paull.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

Welfare Supervision of Factories. Conservation of Life, Commission of Conservation, Canada, July, 1919, 5, No. 13, 56–58. — To maintain perfection in the health of the workers is as much a part of successful factory management as the perfection of processes, or the devising of machinery. In short, the human worker as well as the work must be studied. To this end there should be instituted in every factory a welfare department with the following distinct groups of functions: (*a*) personal — as regards the employees; and (*b*) structural — concerned with the conveniences of the buildings. These functions are described in this article. — L. A. Shaw.

Technical Features of Disston Cafeteria. *Arthur N. Blum.* Safety Engin., May, 1919, 37, No. 5, 247–251. — The benefits derived from industrial restaurants, especially in places more or less distant from town centers, where public restaurants are poor or not available at all, may be summed up in the following:

Direct Benefits

1. Marked improvement in the health of the worker.
2. Less sickness.
3. Less absence and broken time.
4. Less tendency to alcoholism.
5. Increased efficiency and output.

Indirect Benefits

1. Saving time of worker.
2. Salutary change from workshop.
3. Greater contentment of worker.
4. Better midday ventilation of workshop.
5. Increase of recreation and games in spare time.

The Henry Disston & Sons, Inc., Tacony, Philadelphia, while the country was at war, faced with an unparalleled labor shortage coupled with a ruinous labor turnover, realized that no other welfare undertaking could, under the prevailing conditions, be more beneficial and attractive to their employees than a modern factory restaurant. Consequently the company made a thorough investigation and finally based their design and equipment on the following:

1. That the best type suitable for quick service of large numbers (in fact the only type possible) is the cafeteria type of restaurant, in which the men serve themselves in passing along a counter on which the food is displayed.

2. It was decided that facilities, to start with, for about 600 people in one sitting should be provided.

3. It was decided to erect a new building with a view to finally accommodating about 900 people and having kitchen facilities to prepare 1500 meals at one time.

On these basic data this company prepared their technical specifications. The design and equipment which are the result of careful investigation and comparison, are described at length in this article. — R. Thomson.

INDUSTRIAL HEALTH LEGISLATION AND COURT DECISIONS: MALINGERING

Application of the Laws on Industrial Hygiene to Small Establishments. *L. Bargeron.* Ann. d'hyg. pub., March, 1919, 31, 171–176. — There has been considerable discussion in France as to the desirability of limiting the application of the laws on industrial hygiene to small establishments. The author takes the stand that no distinction can be made between small and large establishments. The principle of equality requires that the laws be applied equally to all citizens. If a small manufacturer in competition with large concerns cannot carry out the provisions of the law, he should give up his business. Otherwise he hurts the interests of the nation. — A. Allemann.

Impairment of Health of Coal Miner. Court Decision. U. S. Pub. Health Ser., Pub. Health Rep., August 29, 1919, 34, No. 35, 1976. — "It has been decided by the Supreme Court of Iowa (Gay *v.* Hocking Coal Co., 169 N. W., 360) that a coal miner whose health has been impaired may recover damages for such impairment when it is due to the failure of the employer to properly ventilate the mine as required by law." — K. R. Drinker.

Ordinance Regulating Laundries Held Valid. Court Decision. U. S. Pub. Health Ser., Pub. Health Rep., September 26, 1919, 34, No. 39, 2149. — The Supreme Court of Ohio has sustained the validity of an ordinance of the city of Cleveland regulating laundries (Yee Bow *v.* City of Cleveland *et al.*, 124 N. E. 132). The validity of the ordinance was attacked on the ground " that it provided that before a license could be issued, the laundries were to be inspected by the health commissioner to ascertain that the ventilation, plumbing and sanitary arrangements were satisfactory. It was contended that this gave arbitrary legislative and judicial powers to an administrative officer. The court, however, held the ordinance valid." — K. R. Drinker.

WORKMEN'S COMPENSATION AND INSURANCE

Court Decisions on Workmen's Compensation Law, August, 1916 June, 1919. Special Bull. No. 95 (constituting Part II of No. 87). New York State Dept. Labor. This is a pamphlet of 402 pages covering court decisions during August, 1916 June, 1919, on the Workmen's Compensation Law on subjects other than constitutionality and coverage. This bulletin is in sequence to Bulletin 81 (Court Decisions on Workmen's Compensation Law), published in 1917, and constitutes Part II of Bulletin 87 which presents decisions on the subjects of constitutionality and coverage in the period from August, 1916 to May, 1918. — K. R. Drinker.

Compulsory Health Insurance Legislation. *W. S. Stone.* The National Civic Federation Review, February 15, 1919, 4, No. 9, 5–8. The writer objects to compulsory health insurance legislation, at least in the form in which it was proposed by the Mills Bill (New York Senate, Bill No. 69, January 15, 1917). — G. E. Partridge.

Opinion in the United States on State Health Insurance. Labour Gaz., October, 1919, 19, No. 10, 1190–1191. — A discussion of reports on state health insurance by commissions appointed by the state of Illinois and the state of Pennsylvania. The Health Insurance Commission of Illinois in its final report finds against compulsory health insurance. There is no evidence that compulsory insurance has resulted in an improvement in health. The probable causes of this fact are herein stated. No definite health insurance measures were recommended in the report; but it was suggested that a new commission be appointed with a view to formulating remedial legislation.

The commission expressed the belief that sane means must be found to shift the care for sickness

cases from the shoulders of the sick wage worker. The lower the wage group, the less likely the insurance protection. Commercial health insurance is costly and subject to many restrictions, while the policy of labor organizations is to subordinate sickness insurance to life insurance. For these reasons it seems that those most in need of health insurance are the ones who evade it. — L. A. Shaw.

Some Lessons of the British Health Insurance Act. *Margaret Boudfield.* Am. Labor Legis. Rev., June, 1919, 9, No. 2, 202–203. — One of the first results of the British Insurance Act, the writer points out, was to bring the attention of workers and employers to the need of preventive medicine and unified health service. A most unfortunate feature of the British Act was its permitting of commercial insurance companies to serve in the capacity of approved societies. The writer notes that the tendency in this country (notably New York State) is to avoid a number of the obviously unsatisfactory features of the British Act. — C. H. Paull.

American Health Insurance Bill better than British Act. A Statement by *Mary Macarthur.* Am. Labor Legis. Rev., June, 1919, 9, No. 2, 204–208. — This article calls attention to the fact that we have profited by British experience in developing health insurance legislation. Miss Macarthur points out the provisions in the New York bill for local administration of funds, maternity benefits, and adequate medical and nursing care. The compulsory feature of the bill she considers essential to its successful operation. — C. H. Paull.

Health Insurance Bill as Developed from Tentative Drafts. Am. Labor Legis. Rev., June, 1919, 9, No. 2, 209–224. — A brief history of the development of the health insurance measure which passed the New York Senate, but failed of becoming a law in the Assembly. The bill in its final form was drafted so as to avoid antagonizing various possible opposing factions, among which were Christian Scientists, employers, and physicians. The full draft of the bill is given. — C. H. Paull.

Political Expediency as Well as Social Justice Calls for Action on Health Insurance. *Frederick M. Davenport.* Am. Labor Legis. Rev., June, 1919, 9, No. 2, 239–248. — A portion of an address by one of the sponsors of the New York health insurance bill. Mr. Davenport meets some of the arguments of opponents of the bill. He sees no serious danger of opposition from the medical profession, since that profession was carefully considered in drafting the measure. Legal difficulties should be even less serious than those which were presented in administering the compensation law.

The value of health insurance to the worker is emphasized by statistics from the Pennsylvania survey. The justice of distributing the burden of illness is maintained because of the social aspect of the whole problem. Rather than bring about a condition of greater antagonism between the employer and the employee, health insurance should tend to draw them nearer together by stabilizing labor on the one hand, and providing against unnecessary worry and hardship on the other. — C. H. Paull.

A Reconstruction Health Program. *John R. Commons.* Survey, September 6, 1919, 42, No. 23, 798–801. — Referring to the past experience of industry with the compensation laws and reduction of accidents, the writer calls attention to the economic value of health insurance. He states that the "doctor is the great producer of wealth" in that health is the basis of all productive activity. There is, however, a new and more and more commonly recognized function of the doctor. His chief service to the community must ultimately be to prevent sickness rather than to cure it. To this end, health insurance will make a valuable contribution in providing a consulting physician to whom the man of moderate means can go without feeling that a fee is to be collected at each visit. Industry can well afford to contribute to this cause because of the satisfactory reaction upon workers in cutting down absenteeism and similar wasteful conditions. — C. H. Paull.

REHABILITATION OF DISABLED EMPLOYEES

Dental Mechanics, Baking, Podiatry as a Vocation. Fed. Board for Vocational Education, Opportunity Monographs. — Three pamphlets dealing with the above trades as possible vocational opportunities for disabled soldiers and sailors. — K. R. Drinker.

INDUSTRIAL MORTALITY AND MORBIDITY STATISTICS

Industrial Morbidity Statistics. U. S. Pub. Health Ser., Pub. Health Rep., October 17, 1919, 34, No. 42, 2289–2294. — At a meeting of the American Public Health Association, Section on Vital Statistics, Washington, D. C., October 18, 1917, a Committee on Industrial Morbidity Statistics was appointed and instructed (*a*) to develop the minimum requirements for morbidity statistics into a system of standard morbidity records; (*b*) to prepare tables presenting the essential facts of sick-

ness as they arise from the tabulation of the records referred to; and (e) to outline plans by which employers of labor might be interested to adopt the uniform methods recommended. The work of the committee during 1919 was devoted chiefly to a consideration of the classification of diseases and occupations. An abbreviated list of causes of death in tabular form is appended. — L. A. Shaw.

Income and Infant Mortality. *Julia C. Lathrop.* Reprinted from Am. Jour. Pub. Health, April, 1919, 9, No. 4, 270-274. — An investigation of eight cities by the Children's Bureau approaches infant mortality from the viewpoint of the coexistence of certain conditions of life with varying infant mortality rates. Since these conditions are largely governed by the family income, the earnings of the father were made the subject of careful investigation. Emphasis is laid upon the fact that 46 per cent. of infant deaths occur during the first month of life, and that many of these deaths are caused by conditions antedating birth. The contrast between the most favorable and the least favorable rates in the cities studied indicates the favoring result of income which permits proper housing, proper surroundings and a fair degree of education. — L. A. Shaw.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

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CONTENTS

GENERAL

THE UNIVERSITY OF IOWA AS A STATE MEDICAL CENTRE. *Harold Chamberlain.* Mod. Med., Oct., 1919, 1, No. 6, 478–484. — A popular article from the lay point of view, showing a very suggestive and comprehensive plan of health work in a state built up around a state university with large hospital facilities. The plan combines the care of the indigent poor, hospital care for both children and adults, research, teaching, and laboratory work, and public health instruction. The organization and development should prove of interest especially to state and city departments of health, as furnishing a concrete example of a large health centre that is successful. — A. B. Emmons.

MEDICAL SUPERVISION OF STUDENTS AT WISCONSIN. *C. R. Bardeen.* Mod. Med., Oct., 1919, 1, No. 6, 468–477. — The history of the development of the medical supervision and care of the students at the University of Wisconsin is outlined under three headings: (1) *Prevention of the Spread of Infectious Diseases.* The control of infectious diseases is accomplished by the excellent custom of reporting minor ailments immediately for treatment in isolation. (2) *The Promotion of Good Hygienic Conditions.* This is assured by the medical staff which gives advice in regard to university property and recommends for outside rooming and boarding only the most sanitary premises. (3) *Personal Care.* Instruction in personal and community hygiene and physical examinations, in which the students are graded as in scholastic work, are included in this part of the supervision. Special attention is given to students who receive below B in a physical examination. Active tuberculosis is excluded.

Students are encouraged to consult the medical staff freely. Eighty per cent. seek advice at least once yearly, making 30,000 to 40,000 calls annually. Days in bed average 1 + per student per college year. The results have been striking. Nasopharyngeal infections, in which complication developed, decreased from 50 per cent. to 10 − per cent., and the average time lost from work, from 8½ to 2½ days. These results are an example of what may be called a

test of preventive medicine under most favorable conditions. The development of the physical equipment and staff during nearly ten years is of interest as showing the necessary budget, equipment and staff needed to care for such a group of 5000 persons in an ideal way. Professor Bardeen emphasizes the greater advantage of a quiet individual talk over the formal course for teaching hygiene, especially sex hygiene. This opportunity is afforded by the daily clinic. — A. B. Emmons.

Medical Inspection of Young Workers. Progress, Jan.–March, 1919, 14, No. 1, 25. — This is an article recording the important fact that by the Education Act of 1918 medical inspection and treatment are extended to include those who are in attendance at continuation schools, thus reaching all workers between the ages of fourteen and eighteen. Effects upon housing conditions and upon the conditions in factories, the writer thinks, will be marked, and he expresses the belief that ill-lighted and ill-ventilated factories are responsible for much of the falling off in health that is noticeable in boys after they leave school. Compulsory medical inspection will do much to remedy the bad conditions. — G. E. Partridge.

The Health Conditions of Workers in the Ceramic Industry and Especially of Porcelain-Workers. Zentralblatt für Gewerbe-Hygiene, 1915, 3. (Reviewed in Archiv für Sociale Hygiene und Demographie, June, 1917, 12, Nos. 1 and 2.) — Leymann does not agree with the previous conclusions of Sommerfield in regard to the relations of the processes of porcelain-making to tuberculosis among porcelain-workers. The paper discusses also the use of mortality records in estimating health hazards. — G. E. Partridge.

Social Hygiene. Offentliche Gesundheitspflege, 1916, 1, Nos. 9, 10, 11. — These numbers all contain installments of Dr. Alexander Elster's reports on current activities in the field of social hygiene, and include items on school hygiene, statistics, infection, insurance, etc., for the most part of local interest or relating to conditions during the war. There are brief sections dealing with industrial hygiene; most of the space, however, is occupied with a discussion of the daylight-saving plan, and its continuance after the war. Objections from the standpoint of the schools and of certain industries, and difficulties encountered during some seasons, are mentioned, and it is recommended that data be collected for a careful study of the whole question.

Dr. A. Fischer (No. 11) has given a brief history of social hygiene in which he explains the unusually high percentage of illness in Bavaria, especially as shown by insured women, as due to the extension of women's work in the last decade into occupations physically unsuitable for them, and to a greater extent than in other parts of Germany. Out of the war, the author hopes, better provisions for the protection of the health of the German people will issue, more complete control by laws, and a higher socialism in which health is regarded as a means of public service. — G. E. Partridge.

Wartime Gains for the American Family. *J. H. Tufts.* The International Journal of Ethics, Oct., 1919, 30, No. 1, 83–100. — We have made only beginnings of effective social work, for example, in meeting the conditions of poor housing, underfeeding and depressing surroundings. We have made only a beginning, also, in such important provisions as segregating feeble-minded women during the child-bearing age. Whether we can abolish poverty or not, we certainly have not half tried. We have not attended sufficiently to the factors that influence birth rate. While the war has shown us that we have neglected health in a wholly inexcusable manner, it has, however, put us on the right course. Standards of living, including wages, hours and housing, will change, and there are to be new standards of health, especially in regard to the health of children and to venereal diseases. A change of view has taken place toward a conception of production as a national enterprise and not exclusively as a means of private profit. The greatly increased employment of women in industrial pursuits presents many new problems. Certainly the indiscriminate extension in this direction is full of danger, and may be more destructive than war to the life and health of children and to the morale of the family life. — G. E. Partridge.

Architectural Effort and Chinese Nationalism: Being a Radical Interpretation of Modern Architecture as a Potent Factor in Civilization. *W. H. Chaund.* The Far Eastern Review, August, 1919, 15, No. 8, 533–537. — The author discusses the relation of architecture to national, civic and industrial life. Today the idea of the scientific and healthful city is spreading over the whole world. We must think ahead of our times, and although we must provide first for present needs, city-planning must be conceived in terms of the future. The work of the architect, especially as connected with civic activities, is as vitally related to public welfare as is law or medicine. Good architecture affords the sanitary foundation and environment required for hygienic and normal living. Although the article treats specifically the present conditions in China, it is of general interest, and touches upon some basic problems of hygiene from an unusual point of view. — G. E. Partridge.

The Interallied Congress of Hygiene in Paris. *V. H. Friedel.* Translated by L. A. Averill. The American Journal of School Hygiene, Sept., 1919, 3, No. 3, 61–65. — The war has served to place a new emphasis upon hygiene, and to take it out of the field of the academic. Physical and mental hygiene won the war. With the purpose of promoting the development of health the *Comité National de l'éducation physique et sportive et de l'hygiène sociale* has outlined a broad program. The first meeting was held recently at the Sorbonne. There were

thirteen sections, *viz.*, (1) sunshine and water; (2) sanitary homes; (3) rural hygiene; (4) city hygiene; (5) motherhood and infancy; (6) school hygiene; (7) physical education; (8) and (9) sanitary prophylaxis; (10) industrial hygiene; (11) post-school hygiene and moral prophylaxis; (12) hygiene of travel; (13) economic bearings of hygiene. — G. E. Partridge.

National Conference on Americanization in Industries. *C. S. Carney*. Jour. Applied Psychology, Sept., 1919, 3, No. 3, 269-276. — A report of a meeting held at Nantucket in June to discuss problems of education in industrial organizations. Compulsory attendance at English classes, although strongly supported by some, appeared on the whole to be opposed. The question whether employees should be paid for time spent in class attendance was raised and a census of industrial organizations showed eighteen plants holding classes during working hours, thirty-six holding classes after working hours, and six dividing the class period between employee's and employer's time. Four grades of requirements in regard to the teaching of English were recognized. — G. E. Partridge.

Fourth Industrial Safety Congress. Bull. N. Y. State Ind. Com., Oct., 1919, 5, No. 1, 10. — Announcement and detailed program of the Fourth Safety Congress which was held in Syracuse on Dec. 1, 2, 3, and 4, 1919. — L. A. Shaw.

Report of the American Federation of Labor Delegates to the International Federation of Trade Unions Congress at Amsterdam. American Federationist, Oct., 1919, 26, No. 10, 921-953. — Contains a report of "Committee 2" to the Congress, protesting against the clauses of the *Charter of Labor* as contained in the Versailles Peace Treaty. "Only a simple comparison of the clauses of the official Peace Treaty with the program adopted at Berne (February, 1919) by the international trades unions shows distinctly the insufficiency of this charter." The text of the treaty is not clear about the abolition of child labor, and it makes no mention of the age limit. It fails to limit Sunday work of women as was demanded. It does not regulate home industry or night work, and says nothing about prohibiting dangerous occupations to women or about the employment of women before and after confinement. It does not allude to the non-complete restriction of the labor hours in the unhealthy industries, or to the suppression of the use of poisons. It is unsatisfactory in regard to its clause about the eight-hour day. There is nothing about the sanitary inspection of home industry. The Sunday rest period of thirty-six hours is not provided for. The treaty does, however, guarantee a fair living wage, but it does not make any provision as to the realization of such living wage. No mention is made of unemployment and labor insurance. — G. E. Partridge.

Resolution by the American Federation of Labor Emphasizing the National Importance of Scientific Research. Am. Jour. Psychology, Oct., 1919, 30, No. 4, 433. —

"*Whereas*, scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining, and others must rest; and

"*Whereas*, the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology, and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers, but of the whole population as well, are dependent upon advances in medicine and sanitation; so that the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and

"*Whereas*, the increased productivity of industry resulting from scientific research is a most potent factor in the ever increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase since there is a limit beyond which the average standard of living of the whole population cannot progress by the usual methods of re-adjustment, which limit can only be raised by research and the utilization of the results of research in industry; and

"*Whereas*, there are numerous important and pressing problems of administration and regulation now faced by federal, state, and local governments, the wise solution of which depends upon scientific and technical research; and

"*Whereas*, the war has brought home to all the nations engaged in it the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries governmental participation and support of such undertakings are already active; therefore be it

"*Resolved*, by the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the federal government, and that the activities of the government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the Secretary of the Federation is instructed to transmit copies of this resolution to the President of the United States, to the President *pro tempore* of the Senate, and to the Speaker of the House of Representatives." — G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

WHAT WE KNOW ABOUT CANCER. A Handbook for the Medical Profession. Prepared by a Special Committee of the American Society for the Control of Cancer and Published in Co-operation with the Council on Health and Public Instruction of the American Medical Association. Publications of the American Society for the Control of Cancer, New York, Bull. 14, July, 1919. —This is a 54-page pamphlet which gives in condensed summary form the essence of the best modern knowledge concerning the diagnosis and treatment of the principal forms of malignant disease. The general facts concerning cancer are outlined and then each important type and site of cancer is taken up in detail and the forms, symptoms, standard treatment, and results to be expected are outlined for each type.

The pamphlet may be ordered either from the American Medical Association, 535 North Dearborn Street, Chicago, or from the American Society for the Control of Cancer, 25 West 45th Street, New York City. — K. R. Drinker.

CENTRAL NERVOUS SYSTEM

THE NEW MORON. *C. T. Jones.* The Training School Bulletin, Sept., 1919, 16, No. 5, 76–79.— Many men were found during the army examinations who, according to psychological standards, should be classified as mentally defective, and yet who were able to meet the social requirements of the community in which they had lived. Thousands of men were given a rating of 9 years who seemed to get along and make a good living. The courts, on the other hand, are finding many who test normal, but who, socially judged, are sub-normal. The result is a tendency to shift from the psychological to the sociological criterion. Psychological tests have attempted to measure more or less exactly the extent of cerebral development, and from this to draw conclusions as to what may be expected in the way of social adaptation. This succeeds only with the pronounced cases. Temperament and environment must be not be lost sight of in considering the determining factors. G. E. Partridge.

NERVOUS AND MENTAL DISEASES IN THE WAR. *John F. W. Meagher.* Jour. Nerv. and Ment. Dis., Oct., 1919, 50, No. 4, 331–337. Meagher analyzes the results of examining 24,400 soldiers at Kelly Field who were given a routine nervous and mental examination, and compares these with the figures obtained from examining 30,000 soldiers at Camp Travis where the cases to be examined by the neuro-psychiatrists were referred by the regimental officers. The advantage of a routine examination was shown by the fact that at Kelly Field 28 cases of syphilis of the central nervous system were found as against 1 at Camp Travis. Also, 106 mentally subnormal individuals were found in the routine and only 40 where the referred cases alone were examined. Other figures that are of interest show that at Camp Travis 43 psycho-neuroses were found as against 92 at Kelly Field, 57 psychoses as against 42, and 62 epilepsies as against 39 respectively at these camps. — S. Cobb.

THE CAPACITY FOR MILITARY SERVICE OF THE PSYCHICALLY ABNORMAL. *H. Steizner.* Archiv für Psychiatrie und Nervenkrankheiten, 1916, 56, No. 3, 881–898. — The article is a general discussion, with the presentation of some clinical data, of the types of the mentally abnormal that were found in the German military service, but it has a more inclusive significance as a study of the relations of mental condition to occupation. The writer points out that the World War, far more than any previous war, has brought to the front latent mental conditions. There is a consensus of conclusion to the effect that the war has not produced new diseases of the mind, but has developed latencies. Several types demand practical consideration. Certain cases of organic troubles already determined in their ultimate outcome were merely accelerated by service. There is the neuropathic or psychopathic group, liable to permanent injury if ill-assigned to duties; then, the high-strung, the over-intellectual and highly cultivated, who are always at a disadvantage in some respect in military service; and, finally, the weak-minded in various degrees. The investigations of Wilmans are referred to as evidence that a certain degree of feeble-mindedness does not prevent men from becoming good soldiers, and that the worst cases of breach of discipline, etc., are to be found among those having incipient or actual psychoses rather than among the feeble-minded. The cases reported are of interest mainly from the standpoint of the psychology of war. The important conclusion is that the uncomplicated feeble-minded showed themselves surprisingly enduring of the hardships of war, while the neuropathic and psychopathic were badly affected. — G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

CHRONIC SATURNISM, ULCUS VENTRICULI AND THE VEGETATIVE NERVOUS SYSTEM. *A. Schiff.* Wien. klin. Wchnschr., April 10, 1919, 32, No. 15, 387. — The classical type of lead colic — spastic irritation of the nerves, vessels and musculature of the intestinal and urinary systems — is by no means the most common to be found in usual clinical practice. The greater number of chronic lead poisoning cases suffer from colic of a different sort, consisting of protracted chronic pains instead of single fulminating attacks at long intervals. Of forty-eight such cases studied, fourteen were definitely diagnosed as pyloric ulcer,

and twenty-six gave symptoms of severe gastralgia with marked hyperacidity or hypersecretion. Ten of the latter group showed the typical clinical picture of duodenal ulcer. The majority of all these cases had previously been incorrectly diagnosed as lead colic. Hyperacidity was found in 53 per cent. of these as compared with 29 per cent. in the usual run of patients with digestive complaints. This common occurrence of ulceration appears not to have been hitherto noted. Lead poisoning brings about an intensive secretory irritation in the stomach with consequent ulcer formation. On the basis of these findings, there follows a discussion of the genesis of ulceration in the alimentary tract. — B. Cohen.

Lead Poisoning in Waterfowl. *Alexander Wetmore.* Abstracted from Bureau Biol. Survey, U. S. Dept. Agr., Bull. 793, 1919, 1–12, by W. H. Ross in Chem. Abstr., Oct. 20, 1919, 13, No. 20, 2560. — "Lead poisoning in various species of wild ducks and other waterfowl is shown to have its origin in the large quantity of expended shot that accumulates from year to year at various shooting points, and which are found and swallowed by the birds while searching for food. The stomachs of 28 mallards and 10 pintails that had died from Pb poisoning were found to contain a total of 939 shot, or an av. of almost 25 each. Mallards that had been captured young and reared to maturity when given Pb shot exhibited the same symptoms and post-mortem appearance as those which died from Pb poisoning in the wild state, and 6 pillets of No. 6 shot constituted amt. of Pb that was always fatal. Treatment with $MgSO_4$ led to recovery in about 50 per cent. of the cases to which this was administered but no suggestions of a practical nature are advanced to alleviate the danger of poisoning our waterfowl." — W. O. Fenn.

A Method for the Determination of Minute Amounts of Lead in Urine, Feces, and Tissue. *W. Denis* and *A. S. Minot.* Jour. Biol. Chem., July, 1919, 38, No. 3, 449–453. — An electrolytic method for the quantitative determination of lead in urine, feces and tissue is described. The lead is deposited on the anode as dioxide which is dissolved in potassium iodide and acetic acid, and the iodine set free is titrated against sodium thiosulphate. As little as 0.1 mg. can be detected qualitatively and 0.4 mg. or more determined quantitatively with an error not exceeding 5 per cent. — A. S. Minot.

Benzine Poisoning, with Report of a Chronic Case. *Russell L. Haden.* Bull. Johns Hopkins Hosp., Oct., 1919, 30, No. 344, 309–310. — Haden reviews the chemistry of benzine and the clinical and experimental literature on benzine poisoning. A number of acute cases have been reported. These have been characterized chiefly by cyanosis, miosis, weak pulse, gastro-intestinal symptoms, muscular twitchings, spasticity, unconsciousness and convulsions. Only four instances of chronic poisoning have been recorded previously. These all occurred in a rubber factory.

The case reported by Haden was that of a man of 42 who cleaned the printer's rolls in a lithographing factory by scrubbing them in a trough of benzine from which about 2 gallons evaporated daily. Two months after beginning the work he developed generalized abdominal pains with nausea and vomiting after meals, associated with a feeling of compression in his head. Other symptoms developing during the following few months were weakness and heaviness of the arms and legs, shooting pains, paresthesias, dizziness, drowsiness, mental slowing, tremor of the fingers and eyelids, dimness of vision, anorexia, constipation and finally jaundice.

Examination showed mental dulness, cyanosis, jaundice, palpable liver and spleen, and increased tendon reflexes. There was a slight anemia.

Recovery was prompt and apparently complete. — H. F. West.

Experimental Trinitrotoluene Poisoning. *R. Kramer* and *H. Meierhof.* Abstracted from Proc. Soc. Exp. Biol. Med., 1918, 15, 134–135, by V. C. Myers in Chem. Abstr., Nov. 10, 1919, 13, No. 21, 2709. — "In an attempt to produce experimentally in dogs a state of poisoning by trinitrotoluene analogous to the conditions observed among munition workers, the following methods of administering the poison were employed: (1) Feeding by mouth (TNT in butter); (2) skin innuction (TNT in lard); (3) subcutaneous injections (TNT in olive oil); (4) intravenous injections (TNT in acetone); (5) intraperitoneal injections (TNT in albolene). Only the first 3 methods proved satisfactory. Symptoms observed: (1) vomiting, seen only in feeding cases, apparently due to direct irritation of the stomach by the poison; (2) diarrhea, frequently present (its occurrence is not related to any particular method of administration); (3) depression, surliness, weakness, and emaciation, very marked in later stages; (4) leucocytosis. The outstanding feature of the autopsy findings was the absence of any lesions which would explain the death of the animal." — W. O. Fenn.

Cyanide Poisoning and its Treatment. *H. Fühner.* Deutsch. med. Wchnschr., July 31, 1919, 45, No. 31, 847–850. — Hydrocyanic acid vapor has been used extensively in Germany recently to combat the plague of vermin that has arisen since the war. Previously, cyanide poisoning occurred only from ingestion of the alkaline salts, in gold refining and other industrial arts. Acute poisoning is marked by salivation, metallic taste in the mouth, petechiae on the tongue, and reddening of the forehead. There is a feeling of pressure and pain in the chest, general malaise and vomiting. Weakness and insensibility may be followed by a sharp fall in blood pressure, and death. Repeated small doses are not known to produce any chronic form of poisoning, but may cause an increased susceptibility. A long exposure to a minute amount of the gas, as in a room insufficiently aired after disinfection, may bring on symptoms.

Destruction of the poison in the body seems to be brought about by its conversion into thiocyanic acid

(HCNS) or its salts. The author recommends the subcutaneous injection of large quantities of 5 per cent. sodium thiosulphate to aid this process, and adduces experimental evidence of the value of such a procedure, especially in cases of poisoning by the vapor. Where cyanides have been taken by mouth, he recommends washing out the stomach with a 1 per cent. permanganate solution, and the administration of alkalies. Epinephrin may be given if the heart is weak. Several other drugs which have been recommended from time to time, such as hydrogen peroxide, atropin, caffein, strychnin, and various narcotics, he believes to be valueless. — T. J. Putnam.

The Effects of Chlorine upon Isolated Bronchi and Pulmonary Vessels. *H. G. Barbour* and *H. W. Williams*. Jour. Pharmacol. and Exper. Therap., Sept., 1919, 14, No. 1, 47–53. — Although low concentrations of chlorine in Locke's solution causes dilation of venous, arterial and bronchial muscles, stronger concentrations cause constriction. — Worth Hale.

Drugs After Chlorine Gassing. I. The Influence of Morphine Upon the Fatality of Chlorine Poisoning. *H. G. Barbour*, *A. M. Hjort*, and *F. A. Taylor*. Jour. Pharmacol. and Exper. Therap., Sept., 1919, 14, No. 1, 55–59. — Morphine probably exerts an unfavorable influence upon chlorine-gassed dogs, if the dose is at all large, but in smaller, analgesic doses it does not seem to act deleteriously. — Worth Hale.

Drugs After Chlorine Gassing. II. Observations Upon the Treatment of Gassed Dogs with Circulatory Stimulants. *H. G. Barbour*. Jour. Pharmacol. and Exper. Therap., Sept., 1919, 14, No. 1, 61–64. — It is improbable that either epinephrin or ouabain can be made to exert a favorable influence upon chlorine-poisoned dogs. — Worth Hale.

The Pharmacology of Arsine. *George Joachimoglu*. Arch. f. exper. Path. u. Pharmakol., June, 1919, 85, Nos. 1–2, 32–60. — The author determined the toxicity of arsine for rabbits. He found that 0.38–0.94 mg. per liter of air, when breathed for one hour, caused illness and when breathed for from twelve to forty hours, death. After 0.16–0.30 mg. per liter of air per hour, hemoglobinuria appeared and continued several days. A greater concentration was found in the blood and the blood cells than in the lungs or liver.

The hemolytic concentration for various bloods was determined with results as follows: Human, 1–217,800; Rabbit, 1–500,000; Cat, 1–224,000; G. Pig, 1–268,400; Sheep, 1–268,400. — Worth Hale.

Studies in Uranium Poisoning. II. The Solubility of Uranium Oxide in Artificial and Human Gastric Juice. *H. T. Karsner*, *S. P. Reimann* and *S. C. Brooks*. Abstracted from Jour. Med. Res., 1918, 39, 163–168, by G. T. Caldwell in Chem. Abstr., Sept. 10, 1919, 13, No. 17, 2083. — "Uranium oxide although insoluble in water is soluble in gastric juice. Sugar, fat, and peptone (albumose) do not materially alter the solubility, while milk and casein reduce it. III. The Question of Renal Tissue Affinity for Uranium. *Ibid.*, 169–175. — The excretion of U is chiefly by way of the kidneys. The severity of the functional and anatomical lesion of the kidney, in U poisoning, is probably due to the concn. of the metal in this organ as the result of the attempts at excretion. There is no demonstrable tissue affinity of kidney for U. IV. The Relation of Acid Intoxication to Nephritis. *Ibid.*, 177–187. — Acid intoxication is a practically const. concomitant of U poisoning as ordinarily produced in animals, and is more severe in older than in younger animals. Because of the fact that acid intoxication appears subsequently to, often simultaneously with, but never earlier than albuminuria, it is concluded that the renal irritation of the early stage of U nephritis is not the result of the acid intoxication." — W. O. Fenn.

DUST HAZARDS AND THEIR EFFECTS

Second Preliminary Report of Committee on Mortality from Tuberculosis in Dusty Trades. National Tuberculosis Association, New York City, Sept., 1919. — This report consists of a series of letters between members of the Association regarding the activities of the Vermont Association for the Prevention of Tuberculosis and the Niagara County Joint Committee for the Prevention of Tuberculosis. An outline of a suggested plan of work for Niagara County is given. In closing, a series of statistical tables bearing on tuberculosis mortality in the stone-cutting trades in Vermont is cited. — L. Greenburg.

Cement Inhalation and Its Effect Upon Tuberculous Lungs. *S. Nagai*. Abstracted from Tokyo Igakukai Zasshi, 1918, 32, No. 13, 2–37, and Jap. Med. Literature, 1919, 4, 33, by J. S. Hepburn in Chem. Abstr., Sept. 10, 1919, 13, No. 17, 2084. — "Tuberculosis is uncommon among workers about lime kilns. Guinea pigs were kept in an atm. in which either lime dust or lime dust plus tubercle bacilli were kept in suspension by mech. agitation. The lime dust alone had no detrimental effect upon the lung tissues. The lime dust did not exert any demonstrable beneficial action upon tuberculosis whether that disease was produced by exposure to lime dust plus bacilli, or had its origin previous to such exposure." — W. O. Fenn.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

First Report of the Special Investigation Committee Upon the Incidence of Phthisis in Relation to Occupations: The Boot and Shoe Industry. Medical Research Committee. Special Report Series No. 1, London, 1915. — This pamphlet is devoted to the consideration of the industrial mortality statistics of the Registrar General's Decennial Supplement and also the records of the National Union of Boot and Shoe Operatives, with the purpose in mind of throwing some light on reasons for the high mortality among boot and shoe makers. The process of making shoes is described and the hygienic conditions of the factories in this industry are also discussed. The conclusions arrived at are:

1. Phthisis is specially prevalent among workers in the boot and shoe industry, as compared with the general population.

2. The individual worker is predisposed to infection by the sedentary nature of his employment, and possibly by the attitude he adopts at work.

3. The infection is probably (*a*) increased by the number of infected workers, and (*b*) favored by want of light, the presence of infected dust, and inadequate ventilation in the workrooms. L. Greenburg.

An Inquiry into the Prevalence and Aetiology of Tuberculosis Among Industrial Workers with Special Reference to Female Munition Workers. Medical Research Committee. Special Report Series, No. 22, London, 1919. — The purpose of this investigation was to attempt to account for the fact that the death rate from tuberculosis, which prior to the war had been declining, was found towards the end of 1917 to be on the increase. It was obvious very early that changes in the male death rate would be of no significance, owing to military selection, etc. The data with regard to women would, of course, not be met with this objection, and it was early suggested that the rise in mortality might be due to the entrance of women into industrial life.

The report consists of five parts as follows:

Part I deals with occupational tuberculosis as revealed by the statistics of male operatives, the principal data utilized being from the Registrar General's Decennial Supplement, including the unpublished data for 1910–1912, for the use of which we are indebted to the courtesy of Dr. Stevenson. In this part an attempt has been made to deal with the factor of selection.

Part II is concerned with the occupational morbidity and mortality of women. Owing to lack of trustworthy data, this section is incomplete.

Part III examines the regional distribution of mortality in England and Wales during 1911.

Part IV examines the wartime statistics of England and Wales.

Part V is a general account by Dr. Tebb of factory conditions as observed in Birmingham in 1917.

One portion of the study of especial interest is that in Part IV discussing the value of the ratio of tuberculosis to total deaths. The conclusions arrived at are:

1. The incidence of pulmonary tuberculosis in particular occupations is greater than can be accounted for by the hypothesis that persons employed in such trades are, *ab initio*, of inferior physique and with a low general resistance to disease-producing causes.

2. The general statistics of employed women are insufficient to furnish a ground for exact reasoning as to variations of liability to contract tuberculosis.

3. The incidence of tuberculosis among the inhabitants of towns is greater than can be accounted for by the general lowering of health associated with the home environment of the urban poor, and is consistent with the view that industrial employment introduces a special factor which makes for the development of tuberculosis.

4. The ratio of phthisis deaths to deaths from other causes in age-groups is substantially correlated with the age death rate from phthisis, and a tolerably exact impression of the level of phthisis mortality in a group of districts can be derived from the proportionate mortality index. In individual districts, however, the divergence may be considerable between the observed death rate and that predicted from a knowledge of the proportionate mortality.

5. In the majority of English registration districts the proportionate phthisis mortality at the ages 15 to 45 has increased since the outbreak of war.

6. The position of the maximum in the curve of proportionate mortality (women) is different, and has varied in a different way since the war, in towns of different kinds. This is manifested in the nearly uniform increase of the proportionate mortality (phthisis) at the ages 15 to 20 in the great industrial towns, another result tending to suggest that the wartime increase of phthisis mortality is due to industrialization.

7. A field investigation in the Birmingham area discloses evidence (*a*) of a relatively greater incidence of phthisis among the employees in hygienically unsuitable factories, (*b*) of a serious condition of overcrowding in industrial dwellings, but (*c*) no evidence of any specific trade habit amongst munition workers specially apt to favor the conveyance of phthisis from person to person. — L. Greenburg.

The Employment of Rest and Exercise After Tuberculous Patients Have Returned to Work. *Hugh M. Kinghorn.* Am. Rev. Tuberc., Oct., 1919, 3, No. 8, 483–490. — Kinghorn emphasizes especially the need for after-care and supervision of patients who have been discharged from sanitaria. Especially dangerous from the standpoint of relapse is the return to heavy muscular work and strenuous exercise. The author advises sedentary or light

work, short working hours, much rest and much time spent in the open air for several months after discharge. Office work under good conditions is preferable to heavy physical labor in the open air. All patients should continue the open-air cure in their homes. Individuals who are forced to return to manual labor should have a more prolonged sanitarium treatment. — H. F. West.

Venereal Disease: A National Problem. *William Edler.* Quart. Bull. Louisiana State Board of Health, Sept., 1919, 10, No. 3, 129-132. — An address made before the Orleans Medical Society. Notwithstanding the fact that physicians are in a position to realize the ravages of venereal disease better than the general public, they are inclined to drift along in complacency with the general sentiment that somehow the ugly problem will solve itself. The atmosphere of secrecy that beclouds this disease makes it particularly insidious. Venereal diseases must be included in the same class with all other infectious diseases. The physician must overcome his repugnance to venereally diseased persons.

The next problem for physicians is to gain some organized notion as to the control of the source of infection. Prostitution must be annihilated, not simply restricted. The prostitute must then be isolated and made non-infectious. There must be a thorough system of prophylaxis as applied to the individual. Violation of the laws aimed to prohibit self-treatment must be reported. — L. A. Shaw.

Co-operation of Dentists in Venereal Disease Control. U. S. Pub. Health Ser., Pub. Health Rep., Oct. 24, 1919, 34, No. 43, 2388–2391. — A circular letter has been sent to every dentist in the United States, requesting him to sign and return an enclosed pledge card, and stating that (1) it is necessary to call the attention of the dental profession to the spread of syphilitic infection resulting from dental operations; (2) the dental profession should hold itself responsible for the detection of syphilis which manifests itself through oral lesions; and (3) the co-operation of the dental profession is, therefore, solicited by the Public Health Service in its campaign to check the spread of venereal infection. — L. A. Shaw.

Value of Venereal Disease Case Reports. Weekly Bull., N. Y. City Dept. Health, Nov. 15, 1919, 8, No. 46, 363–365. — Quotations from the U. S. Public Health Reports relating to the current system for reporting venereal infections and to the available means of perfecting this system, with special reference to the duty of physicians in this respect. — L. A. Shaw.

Venereal Disease in Relation to Measures for Child Welfare. *Victoria E. M. Bennett.* The Child, Sept., 1919, 9, No. 12, 529–534. — This article emphasizes the curability of venereal diseases and the need of widespread information about the consequences of neglect, the proper course to be taken in seeking treatment, etc. — G. E. Partridge.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Defense Against Dangerous Articles. *B. W. Dunn.* Abstracted from B. E. Accident Bull., 1919, No. 14, by Charles E. Munroe in Chem. Abstr., Sept. 10, 1919, 13, No. 17, 2129. — " Two recurrent fires in a car transporting $NaNO_3$ in jute bags are described and the imperative necessity of shipping in tight box cars is shown. In a circular designed to enlist the co-operation of shippers of gasoline and owners, lessees and builders of tank cars, it is stated that gasoline is the most destructive article now handled by railroads. The loss and damage to life and property due to its transportation in 1918 exceeded many times that due to the unusually large vol. of explosives required to meet war conditions. The average tank car as now used has defects that cause leakage, and many shippers violate federal law and I. C. C. regulations in preparing and loading them. Condensed comments on accidents cite, among others, one death from handling improperly cleaned machinery from an explosives plant, another due to shipper's failure properly to secure the bung of a supposedly ' empty ' drum, which formerly contained carbolic acid (cresol), while supposedly ' empty ' carbide cans loaded with rubbish by railroad employees resulted in a fire. Eight instructive tables relating to fires and explosions during 1919 are given and also several pages of detailed descriptions of each of the more important recent accidents. Among these was an explosion of a case of toy torpedoes while it was being loaded in a car, through driving a nail into the box when ' staying ' it in place." — W. O. Fenn.

INDUSTRIAL SURGERY

Disability Following Injuries to the Back in Industrial Accidents. *James Warren Sever.* Jour. Orthop. Surg., Nov., 1919, 1, No. 11, 657-666. Records of 134 cases show that unusually long periods of disability prevail after injuries to the back, and that the medical treatment and supervision have not been of the best. These cases were seen by the author as an impartial examiner for the Industrial Accident Board of Massachusetts. Taken as a group, the medical profession has fallen down badly on these cases. More careful and adequate physical examination is absolutely necessary in order to gain more comprehensive treatment. — C. C. Lund.

FATIGUE AND OCCUPATIONAL NEUROSES

WORK-CURVES. *T. R. Garth.* Jour. Educational Psychology, May–June, 1919, 10, Nos. 5 and 6, 277–283. — This is a study of the form of the work-curve, made by the computation method, the subjects being about 700 children. The technique of the experiments, which were performed originally with reference to another aspect of the problem of fatigue, is given somewhat briefly, but the conclusion is reached "that the question as to whether there are types of work-curves in the same sort of work, as in addition of one-place figures, may be answered by the generalization that there are no such things as many types in measurements of any one kind of human process or trait, and that there is only one type. This is a brief statement of the single-type theory. . . . . If the single-type theory is true, then there are no such things as types of work-curves, and Meumann and Kraepelin are wrong." — G. E. Partridge.

INVESTIGATIONS IN INDUSTRIAL HYGIENE. *W. Weichardt.* Öffentliche Gesundheitspflege, 1916, 1, No. 2, 65–82. — This is an experimental study of fatigue by the plethysmographic method of E. Weber. Weber found that in normal unfatigued subjects an increase in the volume of the part studied — an increase, due to central innervation of blood vessels — follows upon increased psychic or physical effort. With the onset of fatigue lessened volume is found. The method is especially practicable, because the phenomenon in question can be measured in parts of the body which do not participate in the movements. Weichardt has made extensive use of Weber's technique and he shows sixteen tracings of plethysmographic and respiration curves in the course of work, the blood curves being taken in the arm and the movement usually being strong flexion of the foot. Weber's phenomenon was found uniformly. Curves taken upon already fatigued subjects showed a tendency to be negative from the beginning. The afternoon curves in general were relatively of this character, but in some strong subjects no difference in morning and afternoon curves could be found. Curves made by schoolchildren indicate individual differences and variable reactions according to previous fatigue, etc. Weichardt considers, also, biochemical aspects of the fatigue problem, and an analysis of fatigue and a tabulation of its factors are offered. There is reference to the writer's experiments of 1907 with acetone extracts as binders of fatigue products, and some curves are presented showing the effects of his "retardine" in eliminating the negative reaction. There is a brief résumé accompanied by a discussion of the methods of studying fatigue and by comments on the practical importance of the subject with reference to the war. — G. E. Partridge.

INDUSTRIAL FATIGUE IN TIN-PLATE MANUFACTURE. Engin., Oct. 10, 1919, 108, No. 2806, 484–485. — Two years ago the British Home Secretary invited the Department of Scientific and Industrial Research to appoint a committee to consider and investigate the relations of the hours of labor and other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers. Such a committee was appointed and its first fruits are embodied in a report on the operations connected with the manufacture of tin-plate in South Wales, by H. M. Vernon, M.D., investigator to the board.

The work of the mill men is very severe, both on account of the physical exertion required and the high temperature in which the men have to work. In several operations a weight of from 40 pounds to 80 pounds has to be lifted by means of long tongs. The temperature of the air in which the men are working has been observed as high as 140° F., but this figure, Dr. Vernon states, gives but an inadequate idea of the heat experienced. Up to the beginning of 1919 the men worked five or six 8-hour shifts per week and now it is suggested that the length of shifts should be reduced to six hours. It is evidently desirable to know what effect such prolonged strain would have on output, and the investigator has collected and discussed information from five typical factories in which conditions of labor, especially ventilation, vary considerably. The conditions for a direct answer appeared excellent, because on emergency, as the breakdown of a mill or temporary shortness of material, the custom of the trade is to convert the three 8-hour shifts into four 6-hour shifts or even six 4-hour shifts in order to distribute the work as fairly as possible among operatives. The conclusion drawn from standardized figures shows that the output of the 4-hour shift arrangement is in excess of that of the normal 8-hour shift by 11.5 per cent.

The author suggests that workers need time to accommodate themselves to new working conditions. A steady level of production is only obtained after the worker perceives that he can speed up his rate of working without incurring over-fatigue. In one factory the mean hour output in all the 6-hour shifts was 8.5 per cent. greater than in 8-hour shifts, but owing to time required for adaptation this figure is probably low, the real measure of improvement being more nearly 10 per cent. Some interesting results are presented concerning the output in the successive hours of the shift, and concerning the length of the rest pauses at the different stages of the work. The results show that the number of minutes spent in recuperation is, in the mean, 12.5 in 8-hour shifts, and 10.2 in 6-hour shifts. The output per hour is fairly uniform. Taking the average production for the whole eight hours as 800, the actual output varied from 77 to 121, but half of the output values lie between 94 and 105. In the 6-hour shift the output is distinctly more uniform. The extremes range from 90 to 110 and the mean values from 96 to 105.

The initial output is above the average, followed by a gradual decline, but in the final hours, especially in the penultimate, there is a noticeable increase. It is claimed that the output varies inversely as the temperature. This claim is based upon a table of the weekly output for six years from one factory. It appears that the average mean percentage of plates produced was 3 per cent. to 4 per cent. above the average from January to March, and then fell gradually to a minimum in August, when it was 4 per cent. below the average. Thence the amount rose again to 2 per cent. above the average. In conclusion Dr. Vernon offers some excellent suggestions calculated to improve the apparatus and to facilitate factory arrangements. — G. M. Fair.

NUTRITION AND METABOLISM

Food Requirements of a Normal Working-Class Family. *Henry Thompson.* Abstracted from Science Progress, 1918, Vol. 13, 79–85, by J. S. Hepburn in Chem. Abstr., Aug. 10, 1919, 13, No. 15, 1722. — " The daily food requirement in large cal., is given as 3400 for the father, 2750 for the mother, 3000 for a boy of 13 yrs. and 2400, 2000, and 1750 for a boy or girl of 11, 9, and 7 yrs. resp. Various British dietaries are described. Bread plus meat provide 55% of the total energy in working-class diets, and 60% of the total energy in the food supplied to the country as a whole." — W. O. Fenn.

Energy Expenditure and Food Requirements of Women Workers. *O. Rosenheim.* Abstracted from Proc. Roy. Soc., 1919, 91B, 44–61, by J. S. Hepburn in Chem. Abstr., Oct. 20, 1919, 13, No. 20, 2550. — " The total food requirement for 24 hrs. was calc. as the sum of the calories required for: 8 hrs. sleep (standard metabolism), 2 hrs. at hard work, 6 hrs. divided equally between light work and medium hard work, 1.5 hrs. walking, 3.5 hrs. sitting, and 3 hrs. standing. This sum was increased by 15% to obtain the gross daily caloric requirement, which was found to be 2400 to 2800 cals. per person." The energy expenditure while working was determined by observations on women working in the manufacture of aëroplane parts. The method was that of indirect calorimetry, using the Douglas bag. — W. O. Fenn.

Efficiency of Oat Protein in Adult Human Nutrition. *H. C. Sherman, J. C. Winters,* and *V. Phillips.* Jour. Biol. Chem., Aug., 1919, 39, No. 1, 53–63. — An experiment is described in which two women for periods of sixteen and twenty-eight days respectively ate diets consisting entirely of oatmeal, cornstarch, apple, butter, sugar, milk and distilled water in such proportion that 85–87 per cent. of the protein was furnished by the oatmeal. Nitrogen equilibrium and body weight were maintained. In a preliminary period in which the milk was withdrawn from the diet, there was a negative nitrogen balance. The conclusion is drawn that for practical dietetics oat protein with a small amount of milk is as efficient as proteins of a mixed diet in maintaining the metabolism of man. — A. S. Minot.

A Peculiar Starvation Disease. *O. Porges* and *R. Wagner.* Wien. klin. Wchnschr., April 10, 1919, 32, No. 15, 385. — An affection of the bones in middle-aged women is described that does not fully coincide in symptoms with any of the known bone diseases. The cardinal symptom, ostealgia without deformations, suggests senile osteoporosis. The disease appears to be due to chronic underfeeding (as a result of war diets), particularly through nitrogen losses of the body leading to nitrogen loss from the bones with consequent degeneration. — B. Cohen.

Dependence of the Protein Requirement on the Mineral Metabolism. *C. Rose* and *Ragnar Berg.* Abstracted from München. med. Wchnschr., 1918, 65, 1011–1016, by J. S. Hepburn in Chem. Abstr., June 10, 1919, 13, No. 11, 1222. — " The protein requirement is at a minimum if the experimental ration contains a sufficient excess of bases during both the fore-period and the experiment proper." If the supply of inorganic bases in the body is deficient, NH_3 is formed in the body and used to neutralize the excess acid. An insufficient excess of bases may increase the protein requirement by from 5 to even 300 per cent., depending upon the conditions of the experiment. " A man of 70 kg. body weight engaged on moderately heavy work requires an excess of 25 mg. equivalents of inorganic bases daily. On a diet rich in acid-forming elements, the energy-utilization is less than on a diet rich in base-forming elements; the energy requirement, therefore, is greater on the former diet than on the latter." — W. O. Fenn.

The Deficiency Theory of the Origin of Beri-Beri in the Light of Clinical and Experimental Observations on the Disease, with an Account of a Series of Forty Cases. *F. M. R. Walshe.* Abstracted from Quart. Jour. Med., 1918, 11, 320–338, by John T. Myers in Chem. Abstr., May 20, 1919, 13, No. 10, 1089. — Deficiency in vitamines is found to be an inadequate cause of beri-beri. A probable second factor is the presence of carbohydrates undergoing an aberrant hydrolysis in the absence of their specific vitamine with the production of toxic by- and end-products. Viewed in this light the disease is an intoxication. Support for this theory is found in clinical observations and in the fact that fowls do not develop the disease when starved, their diet then being deficient in both vitamines and carbohydrates. — W. O. Fenn.

Metabolism of Female Munitions Workers. *M. Greenwood, C. Hodson* and *A. E. Tebb.* Abstracted from Proc. Roy. Soc., 1919, 91B, 62–82, by

J. S. Hepburn in Chem. Abstr., Oct. 20, 1919, 13, No. 20, 2550. — "By means of the Douglas bag determination was made of the energy requirement of women workers engaged in the manufacture of 6-inch shell cases. The subjects fell into 4 groups according to their approx. requirement in cal. per hr. per m^2 of body surface: I. 100 cal. light turning, turning, forging. II. 125 cal. tool setting, heavy turning, stamping, finishing Cu bands, shell hoisting. III. 160 cal. gauging, walking, and carrying. IV. 180 cal. laboring, cleaning, and drying. Assuming a body surface of 1.6 m^2 and a working day of 7 hrs., and making due allowance for the caloric requirements of the body during the remainder of the day, the daily net energy requirement for these groups was found to be 2530, 2810, 3200, and 3425 cal., resp. Adding an allowance of 10%, the daily food requirement became 2810, 3120, 2555, and 3805 cal., resp." — W. O. Fenn.

WOMEN AND CHILDREN IN INDUSTRY

Employment and Substitution of Women During the War. The Women's Industrial News, April, 1919, 22, No. 83, 8–10. — Reports of the Board of Trade and of the Home Office show that by far fewer women than was commonly supposed were added to the industrial class during the war, and that illusion in this respect was caused by the transfer of women from one industry to another. The total number of new workers is about 1,200,000 (in Great Britain as a whole). It is brought out that very few women have taken the places of men as managers, and the reason given is that, at the outbreak of the war, there was no supply of trained women ready to take such posts. In steam laundries, in clothing factories and wherever women were organized in large numbers apart from men, there was a gradual increase in the employment of women in supervisional work. One great advance in the problem of industrial work for women has come with the discovery that, with proper conditions and appliances, many kinds of work hitherto supposed to be unsuitable for women can be performed by them without detrimental effects. In the case of skilled processes, also, there has been a considerable extension of women's work. Very few women can be described as skilled in the strict sense of the engineering trades, which implies ability to put in hand and carry out any given job, on a particular class of work, from drawings only. In many cases, on the other hand, women became skilled in the performance of a few specialized processes. Simultaneous improvement in conditions of work, machinery, tools, labor-saving devices and organization has greatly aided in the development of all labor. The efficiency of women's work as compared with men's, or its "replacement value," is hard to determine. In the semi-skilled operations, where the fairest test can be made, women's work appears to equal men's, and in many cases was preferred by the manufacturer. The whole result is that there is a larger field opened to women because of the war; and the present need of increased production and the fact that so many men are disabled indicate increased permanent employment of women in industry. It is more than ever necessary, therefore, to make the position of women in industry more definite and more regular. Already there is a great increase in the number of women's organizations and in the number of men's organizations that have opened their doors to women. — G. E. Partridge.

Equal Pay for Equal Work. *Dorothea M. Barton.* The Women's Industrial News, Jan., 1919, 21, No. 82, 6–16. — The ultimate aim must be to secure one standard of wages for men and women. Equal opportunities for gaining skill and experience must be granted, with the honest intention to pave the way toward this end. Several conditions and prejudices must be met before the industrial life of women can be greatly improved. Women's individualistic tendencies, their lower standards of requirement in matters of health and recreation, their lack of self-respect as workers, their lack of interest in organization, their uncertain future as industrial workers, and the tendency to make occupation a temporary expedient and to resort to work to gain pocket-money complicate the problems of women in industry. Increased attention must be given to all these factors and to the health of girls and women. Factory arrangements must be devised to meet the needs of individuals who work under them. Relief must be brought to the overburdened housewife. Serious consideration must be given to the whole question of providing for the nation's children, with particular attention to the effect on the status and wages of women. — G. E. Partridge.

A Report on the Causes of Wastage of Labor in Munition Factories Employing Women. Medical Research Committee. Special Report Series No. 16, 1918. — This valuable study had for its primary object the ascertainment of the actual extent of industrial wastage among women employed in munition factories, and consisted in the analysis of the statistics of eighteen factories employing 40,000 people. The conclusion is reached that the extent of labor wastage due to discontinuity of employment is very considerable even in the best managed factories, an amount which must prejudicially affect output. A very large percentage of this wastage is inexplicable, that is, persons who leave their employment without divulging the reasons therefor. The author feels that the most promising means for reducing this is welfare work and this is, in a measure, borne out by the analysis. The use of additional paper system to define these causes for leaving would reduce the statistical "not sufficient reason" group, but would not, on the other hand, keep these people employed. A good system of follow-up would probably help greatly to stabilize matters.

A portion of the study was given over to the con-

sideration of the effects on female workers of various age-groups of *heavy* contrasted with *ordinary* munition work. The conclusion is reached that while the general strain of factory life is not borne worse by older than by younger women, however, when the degree of physical effort is greater, it appears that women over 23 years of age cannot stand the strain as well as their juniors. — L. Greenburg.

England's Care of Mothers — Essentials for Public Care of Maternity and Infancy. *Eleanor Barton.* Child-Welfare Magazine, Oct., 1919, 14, No. 2, 47–49. — This is a report of the work of the Woman's Co-operative Guild of England, which for several years has been devoting special attention to the problem of public care of maternity. The efforts have included the gathering of data, influencing public opinion through the publication of pamphlets, etc. Compulsory notification of births has been secured, maternity centers where advice and minor treatment are provided have been established, and health visitors and maternity homes have been provided. A service of home helps has been organized, especially directed to relieve the burden of working-class mothers. — G. E. Partridge.

Report of National Child Labor Committee. *Mrs. G. B. Chandler.* Child-Welfare Magazine, Oct., 1919, 14, No. 2, 53. — This touches upon questions of public protection of maternity and infancy, mother's care of older children, child labor laws, and the recreation of children and youths. Reference is made to the Children's Bureau of the U. S. Department of Labor and to the National Child Labor Committee, as available sources of suggestions, advice and literature for those interested. — G. E. Partridge.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Ventilating Equipment Reduces Mortality During Winter. *E. Vernon Hill.* Dom. Engin., Oct. 25, 1919, 89, No. 4, 167–168. — The author believes that the low humidity, the excessive amount of dust which we inhale — usually the direct cause of the former — and the many other unfavorable conditions, which are all properly classed under *improper ventilation*, are responsible for the rapidly rising death rate which amounts, conservatively estimated, to not less than 100,000 human lives each year in the United States alone. The statistical reasoning of the paper is not quite clear. — G. M. Fair.

More Air for Offices and Drafting Rooms. *Charles L. Hubbard.* Factory, Nov., 1919, 23, No. 5, 1050–1052. — A brief discussion of possible methods for ventilating offices and drafting rooms in old buildings where arrangements were not made originally for such ventilation. The writer calls attention to the fact that in the case of workers performing tasks which call for mental rather than physical activity, there is an imperative need for a constant supply of fresh air. One of the plans which is suggested is the installation of a fan and heater unit for supplying air at a uniform temperature through ducts carried into the rooms along the ceiling. In a somewhat similarly arranged delivery system, hot air is delivered at a high velocity into the ducts, and air at outside temperature is drawn in and mixed with it before it reaches the rooms for which it is intended. A much simpler and somewhat less satisfactory arrangement provides for small suction or exhaust fans attached to windows. In any system where fresh air is brought into a room by mechanical means care should be taken to provide against undesirable currents. — C. H. Paull.

Ozone as a Disinfectant in Water Purification. *Joseph W. Ellms.* Munic. Eng., Oct., 1919, 57, No. 4, 186–188. — Ozone used as a disinfecting agent is no more a cure-all for a polluted water supply than are other disinfecting agents that are at present more widely employed. As a supplement to filtration, ozone can be used with good effect, and thereby renders the water safe for drinking purposes. — G. M. Fair.

Electrical Treatment of Sewage: The Landreth Direct-Oxidation Process. *H. J. M. Creighton* and *B. Franklin.* Abstracted from Jour. Franklin Inst., 1919, 188, 157–187, by J. S. Hepburn in Chem. Abstr., Nov. 10, 1919, 13, No. 21, 2719. — "Methods for the purification of sewage by electricity are reviewed. A detailed description is given of the Landreth direct-oxidation process (use of both electricity and lime), and of the million-gallon unit demonstration plant for this process installed at Easton, Pa. Results of tests conducted at this plant are reported in detail. Chem. and bacterial analyses were made of both the raw sewage and the effluent from the Landreth app. In order to obtain comparative data, 3 separate series of tests were conducted with the app. treating the raw sewage with (1) both electricity and lime (Landreth's process), (2) lime alone, and (3) electricity alone." The Landreth process showed consistently better results than the other two, causing a greater increase in nitrites and nitrates, greater decrease in free NH_3 and albuminoid NH_3, about double the decrease of required oxygen, and a reduction in the bacterial counts. The average greater bacterial reduction at 20°C. was 92 per cent. with the Landreth process, 90 per cent. with lime alone, and 70 per cent. with electricity alone. At 37°C. the count was 93 per cent. reduction with the electrolytic-lime treatment, 82 per cent. with lime alone, and 38 per cent. with electricity alone. The Landreth plant compares favorably with that of any other process in per capita cost of construction. — W. O. Fenn.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Prospectus for Workingmen's Hospital. Mod. Hosp., Oct., 1919, 13, No. 4, 358. — A new type of hospital is suggested in which the working class rather than the employing class would have a chief voice in the management. The prospectus outlines the objects of such a hospital, its financing, and the control of its policies. — A. B. Emmons.

The Industrial Situation Abroad Following the War. An Abridgment of Reports of the Commission sent by the National Civic Federation. The National Civic Federation Review, Sept. 30, 1919, 4, No. 19, 4–5. — The conditions of the war have inspired among all classes of people a greater interest in humanity and a greater regard for the physical and social conditions under which the masses of the population live. In both Great Britain and France, the governments are adopting measures for fostering individual and associated interest in and the subsidizing of improved industrial and community housing, and the prompt building of modern homes for workers. The houses in Great Britain are described as insanitary, the solid masonry making the introduction of modern improvements difficult. "With few exceptions the housing of industrial workers of Great Britain is in towns and cities which have preceded the industrial plants, and rarely has housing been constructed as an integral part of an industrial plant." In the mining industry, employers have provided housing to an extent of about one-third of the population. Mining towns are likely, therefore, to receive particular attention in Great Britain's immediate housing program. Up to 1916, about half a million persons in England had been housed through constructive housing legislation, at a cost of approximately seven and a half million pounds. The results have been gratifying, however. Model dwellings on cleared slums in London showed a decrease in the death rate from forty to thirteen per thousand. In Port Sunlight, just outside Liverpool, seven-year-old boys average two and seven-tenths inches taller and seven and one-half pounds heavier than those in Liverpool itself. Some details are given of the measures and plans of the government. The paper would be more valuable if references were given for verification of the statements made. — G. E. Partridge.

INDUSTRIAL, PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Good Housing as a Reducer of Labor Turnover. *Boyd Fisher.* National Housing Association Publications, No. 53, March, 1919, pp. 28. — Private employers may be persuaded to build houses for their workmen only when it can be demonstrated that it is for their advantage to do so. Reports from industrial plants throughout the country afford incontrovertible evidence that labor turnover has been greatly increased by the lack of sufficient or decent housing accommodations. The body of this article is devoted to data and information from which conclusions may be drawn relative to this subject. Whatsoever housing plan may be adopted, however, the greatest possible care must be exercised not to interfere in any way with the freedom and rights of the workers; otherwise, such an undertaking would fall far short of its purpose. — L. A. Shaw.

The Cost and Value of Good Housing to our Industrial Life. *Leslie H. Allen.* National Housing Association Publications, No. 54, March, 1919, pp. 17. — The workers of our great industrial centers are restless and dissatisfied. After working a short time in one plant, they move on to the next town where they take up a similar job. Employers are confronted with labor turnover as one of their most serious problems. The losses thus sustained are five in number:

1. The new employee is liable to spoil valuable material or merchandise.
2. It takes him some time to learn his job during which he produces less than his fellow-workmen.
3. He is apt to damage intricate machinery by his carelessness.
4. The foreman has to spend a good deal of his time teaching him his new job — time that should be spent managing the whole shop.
5. The clerical work of hiring the men and paying them off as they leave is quite considerable.

The fact is that, in spite of high wages, the living conditions in our manufacturing centers are so miserable that a workman cannot endure a long stay in one place, and he soon moves on in the vain hope of finding something more endurable. Whether or not the cost of good housing may be defrayed by greater production is yet a question; but quite apart from business considerations, it is our duty to check the rising tide of discontent which is producing anarchistic conditions in this country. The comfort of a decent home will prove a potent factor in the solution of this problem. — L. A. Shaw.

The Health of Manchester. *P. Alden.* Progress, Jan.–March, 1919, 14, No. 1, 1–13. — Manchester is an industrial city with a population of 760,000, the conditions, health control and sanitary needs of which are briefly reviewed in this article. There is nothing new or unusual reported, but the paper attracts attention as a clear presentation of facts. The author states that we are beginning at last to understand the principles of hygiene and preventive medicine, but he appears to think it remarkable that, although Parliament has devoted so much time to public health work, this work has no department of its own. — G. E. Partridge.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

A Group Intelligence Test. *C. E.* and *G. C. Myers.* School and Society, Sept. 20, 1919, 10, No. 247, 355–360. — The "Beta" test as used for the Army made it possible for men who could not read or write English, or even understand English with ease, to make a proper score in an intelligence rating test. The writers of this paper have attempted to work out tests adapted to group-testing of children. The tests and the discussion are of value to any one interested in group-testing in any of its applications. — G. E. Partridge.

A Non-Language Group Intelligence Test. *R. Pintner.* Jour. Applied Psychology, Sept., 1919, 3, No. 3, 199–214. — The writer has worked out a series of tests suitable for testing either children or adults, and especially adapted to intelligence testing where there are many foreigners or illiterates. Thus far the Army Beta Test and Thorndike's Group Test are the only available methods which do not employ language. The present tests, upon which the author says he has been at work for two years, include six non-language tests, arranged for use in group examining, about thirty minutes being required for the whole procedure. The tests are: (1) an imitation test, in which the subject draws lines connecting dots, imitating moves of the experimenter made on a blackboard diagram; (2) an easy substitution test, in which three digits and three symbols are used; (3) a more difficult test of the same kind, using nine digits and symbols; (4) a drawing-completion test; (5) a reversed drawing test, in which the subject completes figures, the models being shown reversed; and (6) a picture reconstruction test, in which the subject indicates the order of a disarranged picture without being allowed to manipulate the parts. Some data on the correlations and tables, etc., showing distribution of scores by ages and scores of two classes of adults, are given. G. E. Partridge.

The Response of a Composite Group to the Stanford Revision of the Binet-Simon Tests. *H. W. Chase* and *C. C. Carpenter.* The Journal of Educational Psychology, April, 1919, 10, No. 4, 179–188. — This is a report of examinations made, by the Terman method, of a group of children in North Carolina. The statistical results cannot be presented in a brief review, but the paper has some importance for its bearing upon the question of intelligence quotients in their relations to environment and social status. The authors think that, if standard tests are to be used throughout the country, a great amount of work must be done in the derivation of norms. We cannot judge satisfactorily the intelligence of an individual without knowing first what normal intelligence means in the community from which he comes. Standards must perhaps be different for rural and for city groups. — G. E. Partridge.

A Standardized Test for Office Clerks. *L. L. Thurstone.* Jour. Applied Psychology, Sept., 1919, 3, 248–251. — The examination here reported has been taken by about 5000 office clerks and has been standardized. The assumption is that a test by means of a sample piece of office work extending over a period of forty-five or sixty minutes is better than a general intelligence test, and more economical than extended observation during trial employment. Thurstone's test has eight processes. The candidate checks errors in addition and subtraction, underscores incorrectly spelled words, cancels letters, learns a short code, alphabetizes and groups names, classifies complex material, performs arithmetical calculations, and matches proverbs according to meaning (a general intelligence test). Some data toward a statistical evaluation of the test are given, showing the following correlations in grade of office work: with accuracy in the test, +.50; with speed in the test, +.42; with schooling, +.47; with age, +.35. — G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

A Welfare Work that Spares no Expense. *Rose C. Armstrong.* Mod. Hosp., Oct., 1919, 13, No. 4, 357–358. — This article gives an account of the welfare work in the Peoples Gas Light and Coke Company, Chicago. The chief feature emphasized is the employees' dining room which provides good food and excellent service at a nominal cost. The work of the medical department includes: (1) medical examinations; (2) general supervision of health; (3) education in hygiene; and (4) first aid. — A. B. Emmons.

ABSTRACT OF THE LITERATURE
OF
INDUSTRIAL HYGIENE

VOLUME I FEBRUARY, 1920 NUMBER 10

CONTENTS

GENERAL

GREAT BRITAIN, ANN. REP. CHIEF INSPECT. FACTORIES AND WORKSHOPS FOR 1918. Parliamentary Paper, Cmd. 340, 1919, pp. iii–vii. — During the past year, as during the war period, much attention was paid to matters of safety, health, and welfare, including reduction in the hours of labor. Experience has shown that an increase in the ordinary hours of work does not necessarily mean an increase in production; that the more the comfort and welfare of the worker is studied and provided for, the greater is his output; and that attention given to accident prevention and health means greater efficiency and reduced charges. Further, improvement will be assisted, (1) by the powers under the Miscellaneous Provisions Act of 1916 which enables the Secretary of State to issue orders requiring special welfare provision to be made wherever necessary, either for individual work or for works of any particular class; (2) by the adoption of the recommendation in the Report of the Whitley Committee for the establishment of national industrial councils representative of employers and employees; and (3) by the appreciation of numerous employers of the benefits to be derived. The past year was especially marked by a great advance in the voluntary movement on the part of employers and workers to reduce hours of labor. The tendency has been to eliminate work before breakfast with apparent satisfaction to all concerned.

At the instance of the Home Office, the Department of Scientific and Industrial Research and the Medical Research Committee have jointly appointed a body of experts known as the Industrial Fatigue Research Board to investigate the relations of hours of labor and other conditions of employment (including methods of work) to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers. Its work should have an important bearing on future regulation of the hours of labor.

Safety has been much extended by education. In spite of the enormous increase in industry in the amount of machinery and in the introduction of female labor, the total of reportable accidents has decreased. There was some increase in the serious machinery and fatal accidents, the decrease being

entirely in the non-machinery class of accidents. It is suggested that the chief cause of the decrease is the greater care exercised by managers and foremen in works in which women were largely introduced, and the extension of the safety-first movement. At a meeting of employers and workers in industry generally, there was formed the British Industrial Safety First Association; and a considerable amount of propaganda work has already been undertaken by this body.

Welfare has been extended largely by (1) the conditions attached to the Emergency Orders issued by the Home Office relaxing the statutory periods of employment; (2) the Reports and Memoranda issued by the Health of Munition Workers' Committee; (3) the establishment of a Welfare Section in the Ministry of Munitions; and (4) the powers to make Welfare Orders given to the Home Office in the Act of 1916. Enlistment of the active sympathy and co-operation of employers and workers has been sought and the establishment of joint industrial councils welcomed. Steps have been taken to get into touch with each council at an early meeting to bring before it such matters as the health, safety, and welfare of the workers, and to urge co-operation not only in carrying out statutory requirements, but in considering and bringing about further improvements.

Cases of T. N. T. poisoning fell from 190 in 1917 to 34 in 1918. A considerable increase has been reported in cases of anthrax among wool workers. The Departmental Committee on Anthrax made far-reaching proposals in its report last year. A bill based on these proposals has recently been passed and provides for the prohibition of importation of goods infected with anthrax, and authorizes arranging for the disinfection of infected foods. In the meantime, steps are being taken by the Home Office to set up an experimental disinfection station.

The following special reports are appended to the Annual Report of the Chief Inspector:

Hours of Work, by R. E. Graves, Deputy Chief Inspector.

Accident Prevention and Safety First, by G. Bellhouse, Deputy Chief Inspector.

Labour-Saving Appliances, by G. S. Taylor, Inspector for Dangerous Trades.

Welfare in Factories and Workshops, by Miss A. M. Anderson, Principal Lady Inspector.

Ambulance and First Aid, by J. C. Bridge, Medical Inspector.

Continuation Classes, by G. Bellhouse.

Use of Electricity in Factories, by G. S. Ram, Electrical Inspector.

Industrial Poisoning, by T. M. Legge, Medical Inspector.

Abstracts of these special reports are classified according to their respective subjects. — Barnett Cohen.

Need and Method of Co-ordinating Federal, State and Local Health Agencies in Promoting Industrial Hygiene. *J. W. Schereschewsky.* Am. Jour. Pub. Health, Dec., 1919, 9, No. 12, 937–942. — This author says that what the country needs is not extension of federal authority so much as health education of the people to support what exists. The U. S. P. H. S. has already all the power that may constitutionally be given to a federal agency; it has a distinct industrial health program, and all it needs is good financial support.

This program has already been published in Supplement No. 36 to the Public Health Reports of May 9, 1919, as part of a general health program to meet after-the-war needs proposed by the Public Health Service. This program was presented to Congress by the Secretary of the Treasury with an urgent appeal to provide the funds for carrying it out. So far, Congress has not appropriated the funds.

The section of the program dealing with industrial health includes:

1. Health surveys of industries.
2. Industrial morbidity reporting,
3. Adequate systems of medical and surgical supervision of industrial workers,
4. Establishment of minimum health standards,
5. Improvement of the sanitation of industrial communities,
6. Medical and sanitary supervision by the Public Health Service of civil industrial establishments owned or operated by the federal government. — H. F. Smyth.

The Physician and Surgeon in the Industrial Crisis. *Otto P. Geier.* Am. Industries, Nov., 1919, 20, No. 4, 26–29. — The writer points out that in the past one of the great faults of the so-called industrial physician has been his failure to appreciate the fact that his work differed essentially from that of the family physician. The real industrial physician must "enter into the life and understanding of industry. He must have knowledge of the sanitary standards of plants, of occupational diseases, the subject of fatigue, the principles of safety work." He must visualize through the worker "the shop, the bench, the particular occupation that is affecting him; the dirt, the danger, the monotony, and the home environment." He must educate as well as heal. In this way he will make his contribution toward humanizing industry. He will become a real factor in the solving of labor problems. — C. H. Paull.

Reviews of Social Hygiene. *A. Elster.* Offentliche Gesundheitspflege, 1917, Nos. 3, 4, 5, 7. — These reviews contain brief summaries of lines of progress in special branches of hygiene, such as housing, child welfare, school and industrial hygiene, contagion prevention, etc. Special attention is given to the legislative aspects of the problems and to such questions as social insurance. Local problems issuing from war conditions are the chief topics of the reviews, but there are items that will be of interest especially to one who is giving attention to problems of insurance.

Number 4 of the above mentioned periodical contains a brief but valuable summary of recent litera-

ture on disinfection apparatus (p. 223–224). — G. E. Partridge.

Industrial Welfare Activities. National Association of Corporation Schools Bulletin, Jan.–Oct., 1919. — These numbers contain many brief articles that are of interest from the standpoint of industrial problems. There are several accounts of experiments in co-operative and representative organization and control of industrial plants, and of welfare activities, such as the plan of the Midville Steel and Ordnance Company, the employees' representation plan of the Western Union Telegraph Company, the employees' restaurant at the Wisconsin Steel Works, the dental clinic of the National Cash Register Company, the Goodyear industrial representation plan, and the medical department of the New York Telephone Company. There is a general report of progress in the movement to insure employee representation in management. — G. E. Partridge.

Welfare Work. National Association of Corporation Schools Bulletin, Nov.–Dec., 1919, 6, Nos. 11 and 12. — These numbers contain several brief reports of welfare work, including an account of the aid association of the Packard Motor Car Company, a voluntary association of employees inspired by the epidemic of influenza and intended to make provision for protection in case of sickness or accident. There is also a report of the Goodyear representation plan, in which specific benefits of the plan are mentioned. There are articles on democratized industry; the use of the municipal university to increase industrial education and welfare; aiding employees to personal development; an educational system for a modern department store; the housing plan of the National City Bank of New York; the organization policy of the Bell Telephone System. G. E. Partridge.

Data and Recommendations for the International Labor Conference, Washington, October 29, 1919. Am. Labor Legis. Rev., Sept., 1919, 9, No. 3, 302–314. — A brief outline of the origin of the International Labor Conference as it was provided for in the terms of the Peace Treaty. The first meeting of the conference was to be in Washington where the following questions were to be considered:

"1. Application of principle of the 8-hours day or of the 48-hours week.

2. Question of preventing or providing against unemployment.

3. Women's employment:
   (a) Before and after childbirth, including the question of maternity benefit.
   (b) During the night.
   (c) In unhealthy processes.

4. Employment of children:
   (a) Minimum age of employment.
   (b) During the night.
   (c) In unhealthy processes.

5. Extension and application of the International Convention adopted at Berne in 1906 on the prohibition of night work for women employed in industry, and the prohibition of the use of white phosphorus in the manufacture of matches."

The organizing committee prepared preliminary reports dealing with the history of each of the five labor questions as they have received recognition in various countries. The committee further made recommendations regarding the procedure of the conference in dealing with each question. It favored the 48-hours week with a maximum number of hours of overtime per year and recommended the careful consideration of means of reducing unemployment to a minimum. In connection with the employment of women, action was recommended in the regulation of uniform hours of work, the provision for maternity benefits, and the regulation of work in unhealthy processes. In considering the employment of children, the committee called attention to the desirability of a minimum working age and of regulations as to the employment of children in unhealthy occupations. — C. H. Paull.

International Labor Standards and their Possible Enforcement in the United States. *G. W. Wickersham.* Proceedings of the Academy of Political Science, July, 1919, 8, No. 3, 50–67. — In this paper the writer has reviewed the recent conventions and discussions, such as the British National Industrial Conference, the program of the General Confederation of Labor in France, the Conference of the American Federation of Labor, in most of the programs of which he thinks that three fallacies have been involved: (1) that better conditions for the commonwealth than those which prevail can be secured by entrusting the government with the ownership and conduct of important industries; (2) that the policy of giving to organizations of workers control over the means of conduct of industry can result in the permanent betterment of such industry; and (3) that the grant of larger wages to the workers will reduce the cost of living and increase the general prosperity. We cannot, however, return to the old system of unrestricted control of workers by employers. In fact, the prosperity of the country rests upon securing a just balance between the right recognition of the share of the worker in the profits of his industry and the necessarily greater profit to be allowed to the planning and directing brain. — G. E. Partridge.

International Labor Legislation and How it Can be Enforced in the United States. *A. I. Elkus.* Proceedings of the Academy of Political Science, July, 1919, 8, No. 3, 80–85. — It is very important now to create standards that can be recognized by all the great nations of the earth, especially with reference to men, women and children in industry. As the foundation of all international standards there should be the agreement that no child under 14 years should be permitted to work. There should also be a provision that children between the ages of 14 and 16 should be limited to certain kinds of work,

and should be allowed to work only a limited number of hours, and only under the condition that their education is to be continued. Some standard in regard to hours of labor must be established so that all man-provided local conditions do not interfere, but may have a common norm for the working life. Everywhere there must be a principle of the living wage. There should be a universal provision that every worker have at least one day in seven for rest so far as peculiar conditions do not make this impossible. Men and women must be paid alike for equal work. These are the cardinal principles upon which an international agreement might work. Every one of them has as its foundation some inalienable human right. — G. E. Partridge.

The Four Partners in Industry. *J. D. Rockefeller, Jr.* The Forum, Feb., 1919, 61, No. 2, 178–188. — Capital, management, labor and the community, the four partners in industry, have a common interest of such a nature that they cannot afford to be antagonistic to one another. Organization of each party with reference to industry is legitimate and necessary, although it has its dangers. The greatest problem with regard to the welfare of labor and of the other parties interested in industry is to secure the right representation of all in the control of industry. The Whitley Report made by the Reconstruction Committee, now the Ministry of Reconstruction, in England is discussed, and the various plans that have been suggested or put into operation independently by great corporations in this country. Methods of representation, the President's industrial representative, and the employees' right of appeal are briefly commented upon. An industrial creed, or set of basic principles, is offered, which the writer thinks might be used as a means of establishing a sound and lasting co-ordination of the four parties in industry. — G. E. Partridge.

Industrial Losses. *B. J. Newman.* American Federationist, Nov., 1919, 26, No. 11, 1032–1034. — Industrial work as directed in this country today is wasteful to such an extent that, if the waste were corrected, payment of a living wage to all workers would be possible, capital also having a fair return. It is estimated, for example, on the basis of numerous surveys that every year industry in the United States loses through illness about 280,000,000 working days. More than half of this loss is unnecessary, being in part due to inefficient health work in industrial communities, and, to a still greater degree, to working conditions which injure health. Few industrial plants as yet tabulate their records of absence, although this is important both from the standpoint of the employer and in the interest of the workman. The cost of production is increased by interruption of work, and the aggregate loss to the worker is very large. One factor in the remedy must be the determination of the effects upon health of all the processes of industry. For most of the hazards, definite engineering and other preventive measures are available. How extensive this problem is can be understood from the fact that there are now known 126 processes in which dust is alleged to be a health hazard, and 650 processes in which poisons are to be guarded against. Another very important factor in the reduction of losses from sickness, one not as yet sufficiently emphasized, is the adequate provision of personal service facilities of a sanitary character in proper proportion to the number of employees. — G. E. Partridge.

Taking the Guesswork out of Employment. *Alfred Fischer.* Factory, Nov., 1919, 23, No. 5, 1057–1058. — In this brief article, Mr. Fischer outlines some of the activities of the Red Cross Institute for the Blind. In looking for opportunities to place blind workers, this organization has made a series of studies in different industries with the idea of determining what the physical requirements for various jobs actually are. The results of these studies have been recorded in graphic form with a series of symbols to indicate the qualifications in the case of each job. — C. H. Paull.

The Paper Box Industry and the Strike. Bull. N. Y. State Ind. Com., Oct., 1919, 5, No. 1, 8. — An analysis of the condition of women employed in the paper box factories of New York City, based upon data furnished by the survey made by the Bureau of Women in Industry. — L. A. Shaw.

Short-Hour Campaign of the Textile Workers. *J. Golden.* American Federationist, March, 1919, 36, No. 3, 247–248. — The United Textile Workers of America have undertaken the task of bringing about the eight-hour day for every textile worker in the country. — G. E. Partridge.

Reasons Why Night Work Should be Abolished in Bakeries. *C. Iffland.* American Federationist, May, 1919, 36, No. 5, 407–409. — If the statements made in this paper are correct, the conditions of work in bakeries are very bad, and unnecessary night work is continued from force of habit and from a spirit of competition that has led bakers in the past to outdo one another in early delivery of their goods. Some data in regard to the bad effects of night work in general are given, in the form of quotations from physiologists and others. — G. E. Partridge.

On the Creation of Inspectors of Industrial Hygiene. *Deizy.* Rev. d'hyg., Sept., 1919, 41, No. 9, 813–824. — Text and exposition of proposed modifications of the existing French law governing the appointment and duties of inspectors of industrial hygiene. — Wade Wright.

National Supremacy, Industrial Education and Co-operation. *G. F. Arps.* School and Society, Nov. 1, 1919, 10, No. 253, 501–509. — The writer pleads for a broader conception of industrial education and of the relation of the human organism to industry. The great error in the past has been the treatment of labor as essentially physical, to the

neglect of the psychological factor. It is the power of adaptation and learning, and the capacity for originality that are of the highest importance in industry; therefore a detailed study of the nature of the human organism and its mode of behavior is essential to the solution of the relation of the man to his work, and of the man to his employer, the former being the more fundamental problem. "The secret of integrity, industry, and thoroughness consists in anchoring the youth, destined by choice or circumstances to pursue an artisan calling, to that form of educational training which will avoid two undesirable alternatives, namely, (1) leave him unskilled or relatively so and (2) let him, if possible, acquire skill vicariously in the declining formative period." The writer points out that (according to a Congressional Report of 1914) less than 1 per cent. of the 14,250,000 engaged in the industries in the United States have had an opportunity to become skilled workmen. The wastage from lack of skill is not the only loss; we must consider also the wastage in national character. The remedy is a thoroughgoing system of industrial education, which will have for its main purpose furnishing skilled labor to the industries. These schools should be trade schools in every sense of the term, and in no way an appendage of the old school system. — G. E. Partridge.

The Education Act of 1918. *A. E. Dean.* L'Education, March–June, 1919, 11, Nos. 1 and 2, 32–41. — The writer analyzes and comments on the English Education Act of 1918, and thinks it is a very important advance in English education. In an historical sketch it is pointed out that great educational reforms are likely to follow great wars, as is shown by the reforms in Germany after the Napoleonic Wars, in England after Waterloo, and in France after 1870. The increased centralization of the new educational plan, the regulation of child labor, school attendance, medical service and physical culture are discussed, but the writer maintains that the introduction of the supplementary school for workers is the most radical and the most important of all the changes provided for by the English Education Act. Its greatest significance is its place as a definite and historically marked turning of interest in the direction of the education of the adult. — G. E. Partridge.

Argument for Larger Projects Suggestive of Community Activity. *T. R. Foulkes* and *T. Diamond.* Manual Training Magazine, Sept., 1919, 21, No. 1, 5–8. — A study of the projects made and used by 1532 pupils in manual training classes in thirty-six cities of Wisconsin shows both a need of and a natural interest in projects in which there is group interest. There ought to be provision for one large project, on the community plan, by each class or each school every year. — G. E. Partridge.

The Field of Manual Arts in Terms of Present Needs. *I. S. Griffith.* Manual Training Magazine, Sept., 1919, 21, No. 1, 1–5. — Some suggestions are made with reference to the adjustment of manual training work in high schools to meet the requirements of different classes of students. An industrial intelligence course or an industrial economics course should be a part of the curriculum of the general education course. — G. E. Partridge.

The Psychological Foundations of the "School of Work." *A. Ferrière.* Revue psychologique, 1914, 7, No. 2, 105–140. (Received Oct. 7, 1919.) — This is an important study of the psychological and biological foundations of education through productive activity. Such terms as *Arbeitsschule* and *Manual Training Schools* are criticized as meaning something less than work as an educative process implies. True work is a spontaneous and intelligent activity that springs from within. The author's "School of Work" does not exist anywhere in a completed form, but various aspects of it are represented in many schools — i. e., wherever there is activity that is productive and individual. The argument of the paper will not be new to those who have in mind the biological principles of education as elaborated by G. Stanley Hall, and the sociological background of educational theory worked out by John Dewey, but there will be found here a thorough and profound study of the relation of manual activity to both practical and general education. Manual work, even definite occupation, may be taught practically, but there is a wide difference between mechanical and creative work. A classification of interests according to age is offered, five periods being distinguished: period of play; of immediate interests; of specialized interests; of simple abstract interests; of complex abstract interests. The applications of the principles of activity to manual work, intellectual culture, social and moral development are suggested. The education of the present time is still too exclusively verbal and intellectual. Education must once more become what it was before pedagogues made it artificial — a form of action and reaction between the individual and the world in which he lives. — G. E. Partridge.

Continuation Classes. *Gerald Bellhouse.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 51–56. — The new Education Act will bring to an end the half-time system of employment of children; and secondly, it will establish a different part-time system, under which all young persons, with certain exceptions, will be required after leaving day-school to attend continuation schools until they reach the age of 16 years. Henceforward no children will leave school till they are 14, and after that age all will be required to continue their education. Numerous industrial plants have undertaken voluntarily the establishment of continuation classes for their juvenile employees. There is considerable variation in the application of the various educational schemes. In many cases attendance at school is compulsory and is a condition of employment; in others, it is voluntary but the firms offer inducements to encourage attendance. There are also variations as to eligibility, payment of fees, adjustment of hours and types of inducement

to attend. Details are given of the schemes followed in ten different plants. — Barnett Cohen.

The Vocational Counsellor and His Work. *H. E. Stone.* Education, Dec., 1919, 11, No. 4, 214–216. — During the past decade a new specialist has appeared in the world of education — the vocational counsellor. In many large cities there are such specialists devoting all their time to the work of guidance and research. The aim of the article is to show the opportunities offered to men and women who desire to specialize in this branch of applied psychology. — G. E. Partridge.

Choosing a Vocation in Junior High School. *F. P. Whitney.* Education, Oct., 1919, 11, No. 2, 120–126. — The writer has made an investigation, by questionnaire, of the occupational preferences of 805 high-school pupils — 392 boys and 413 girls. One result of the inquiry is the discovery of the absence of any relation between family occupations and the choice of the child. In but nine cases did boys select the father's occupation. One child in forty chooses the same calling as some other member of the family, and only one in eighty the same calling as the father. Nearly half of the children admitted that they knew practically nothing about the father's work. The study indicates to the writer that it is dangerous to base either industrial training or vocational guidance upon other than a very wide survey of the industries and callings that are open to men and women everywhere. Boys and girls leaving school are confronted with an almost innumerable variety of possible occupations. The problem seems to be to reduce the number of haphazard choices and resulting misfits.

The immediate and specific needs are: (1) the addition to the industrial course for boys of work along electrical lines, and also of work on machines; (2) the extension of opportunities to learn typewriting and other commercial occupations, especially for girls; (3) the development of vocational guidance; (4) the provision of a different type, as well as material, of instruction for those destined to leave school before entering the senior year of the high school. This might be of the nature of prevocational education. — G. E. Partridge.

The Future of Agricultural Education. *T. F. Hunt.* School and Society, Oct. 4, 1919, 10, No. 249, 381–388. — The author discusses the place of the teaching of agriculture in the secondary school. As the secondary school is usually chosen for the pupil, it should offer, therefore, the widest possible range of opportunity. In the opinion of the author, high schools will generally obtain the best results if they do not attempt to teach more than two years of agricultural subjects. One year with thorough instruction, whether on the Smith-Hughes plan or standard agriculture, will be better than two years indifferently taught. One-eighth of the time in the high school is sufficient to give to agricultural or other vocational study. In general, the aim should be to continue education to the time of majority, or else the age of majority should be changed, and during the years just preceding majority vocational education should be most emphasized. It is especially important that the agricultural student be of age when he is ready to go to work.

In planning agricultural courses, the fact that the number of people desiring such training is proportional to the total population in a district, not to the number of farms, must be considered. It is a human interest and not only a trade interest that determines the desire. A great number of the students in agricultural colleges come from the cities. — G. E. Partridge.

Increased Production Through Industrial Training. The National Civic Federation Review, Jan. 1, 1920, 5, No. 1, 12. — The relation of factory industrial training to the world-wide need of increased production was given consideration at a special meeting recently called by the Chairman of the Industrial Training Department of the National Civic Federation. Enormous increase in production has been shown to occur whenever there has been introduced a vestibule school in which beginners are trained, the skilled up-graded, and new employees tested for proper placement. There is an inclination now to continue to benefit by the experience gained during the war and to develop the educational side of industrial organization. — G. E. Partridge.

Selected Bibliography of Physical Training and Hygiene. May–August, 1919. American Physical Education Review, Dec., 1919, 24, No. 9, 496–502. — Contains sections on child welfare, eugenics, food and nutrition, health and social insurance, industrial hygiene, mental hygiene, public hygiene, school hygiene and social hygiene. — G. E. Partridge.

Monthly Record of Current Educational Publications. Bureau of Education, Bulletin No. 67, Washington, 1919, Government Printing Office. — This contains sections on child welfare, manual and vocational training, vocational guidance, vocational tests, agricultural education, commercial education, education of soldiers, etc. — G. E. Partridge.

Lice: The Diseases Carried by Them and the Measures Available for the Protection of Children and Civilians. *A. Bacot.* School Hygiene, March, 1919, 10, No. 1, 33–48. — The writer, who is entomologist to the Lister Institute of Preventive Medicine, England, has contributed a valuable study upon the position and relationship of lice, their habits and life history, the effects of their bites, their part in the transmission of diseases, preventive measures, methods of destruction, remedies, etc. The details given in regard to remedies will be of practical use to health officers and nurses. There are data about laboratory tests with non-mercurial compounds. — G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Arsenic Poisoning From Coal Products. *A. Bayet* and *A. Slosse.* Bull. Acad. Med. Belgique, May, 1919, 29, No. 4, 607–626.—The writers establish that the industrial diseases due to coal and its products (soot, tar, pitch, anilin, etc.) are all very similar and show a great similarity to arsenic poisoning.

Now, by careful analysis. Professor Slosse has constantly found arsenic in soot, tar, pitch, etc. In the hair, blood and urine of pitch workers, arsenic has also been found. Even in the skin and in a cancer removed by operation, arsenic was present. It did not exist, on the contrary, in the hair of workmen living in the same village but not connected with the pitch industry. So the authors conclude that the coal products are causing not only irritation, but a real arsenic poisoning. — René Sand.

A Study of the Munitions Intoxications in France. *Roger G. Perkins.* U. S. Pub. Health Ser., Pub. Health Rep., Oct. 24, 1919, 34, No. 43, 2335 2374. — This study was made by Dr. Perkins under the auspices of the National Research Council, and was carried on while he was in Paris, the Ministry of Munitions having put at his service all of the material collected in the course of an extensive inquiry into the intoxications among munition workers in France during the war. While in England and the United States trinitrotoluol was the explosive which gave the most trouble, the French had scarcely any trouble at all in connection with its use, but dinitrophenol gave rise to a good deal of poisoning and Dr. Perkins' paper deals chiefly with this explosive.

The favorite French explosive is a combination of dinitrophenol, trinitrophenol (or picric acid) and trinitrotoluene, in varying proportions, a 40–50 mixture of D.N.P. and T.N.P. being the one most used. It was not possible to ascertain the exact number of workmen exposed to these compounds nor their racial distribution, because under the stress of war it was necessary to change groups of men from one place to another, and even to move the factory physicians from place to place, so that there could not be continuity or uniformity in the records. The actual cases of poisoning, however, were for the most part recognized and recorded.

Dinitrophenol is made by the French from benzene by the formation of monochlorbenzene which, by treatment with mixed acids, is changed to dinitrochlorbenzene. Further treatment by NaOH substitutes NaO for the Cl (NaCl), and the Na is removed by treatment with HCl, leaving the completed dinitrophenol.

It is obvious that there are six isomers possible, all of which are known, but the ordinary D.N.P. is the isomer 1–2–4. A further nitration results in the formation of trinitrophenol, which is again possible in six isomers, of which the most common is the isomer 1–2–4–6 (the ordinary picric acid or melinite).

Of the three portals of entry the skin is the most important, though in certain cases the records seem to show that the poison entered through the respiratory tract, and it is also possible that all three portals may be used. The work of Guerbet and Mayer shows that in the body D.N.P. is changed to reduction products, which may be recovered, together with unaltered D.N.P., in organs, blood and urine. The detection of one of these products, amino-2-nitro-4-phenol by the violet reaction of Derrien constitutes a test of decided clinical value.

There is a marked variation in susceptibility to this isomer which is not dependent upon age, for there was no child labor at all; all the workmen were within the mobilization age and there was no difference between the two limits of this age group. Nor did sex play any part, for no women were employed in the dangerous processes. In connection with the race factor in susceptibility, there are some interesting points. The men came from various parts of France and her colonies, so that there were men from the yellow races, Chinese and Annamites, and from the black, the Senegalese. In general, it was found that the Annamites were the least affected, the Senegalese next, and the whites most, but when he came to analyze these facts more closely, Dr. Perkins concluded that this apparent racial difference depended really on other factors, such as better discipline among the colonial workmen and more careful medical examination of the whites than of the colonials, leading to the detection of more cases. He believes that the susceptibility of all was probably equal. Alcoholism was found to play a very important part in predisposing to poisoning with D.N.P. and efforts were made to eliminate as far as possible the heavy drinkers.

The presence of albumin in the urine indicates marked susceptibility and it was the regular practice to exclude men with albuminuria. No relation between intoxication and lesions of the respiratory tract was found, but it was considered that the general physical condition of consumptives rendered them more susceptible. In general, it appears that the resistance in persons with a low grade of physical condition is less than in the healthy, and this is emphasized by the fact that in many cases workers who have been apparently resistant over long periods of time, if they are sick or overworked, may suddenly develop symptoms.

The clinical picture was worked up by Professor Etienne Martin, who describes three forms: 1. *Subacute intoxication*, which is important as enabling the physician to remove the worker from danger in time. There is anorexia, with a white and furred tongue, followed by nausea and vomiting; there may be diarrhea and colic. It is only exceptionally that there is icterus. There is complaint of decided loss of weight, general weakness with headache and dizziness, with moderate sweats, especially at night. A few days of rest are usually enough for a complete cure. The urine shows a positive Derrien, and when this increases or remains at a fairly high point it is a warning of an acute attack.

2. *Acute intoxication.* This usually follows the symptoms just described, with a sudden onset, complaint of having the arms and legs "cut off," of painful constriction at the base of the chest, and a burning thirst. The face is pale with slight cyanosis of the lips. There is abundant sweat and a characteristic agitation and anxiety. The breathing is short and difficult, especially inspiration. There is a moderate rise of temperature, but the pulse is regular and, with the occasional exception of a few râles at the bases, the lungs are clear. There is a marked diminution of the quantity of urine and a positive Derrien of increasing intensity, improvement being marked by increase of urine. Removal from work with a rest cure, is usually followed by rapid recovery, but no immunity follows such an attack, and these men require careful watching.

3. *Fulminating intoxication.* This is especially noted among alcoholics or persons with renal or hepatic troubles: death may take place in a few hours. The onset is sudden, with an attack of weakness or, less often, violent colic and diarrhea. A few hours later there is fever up to or over 40°C., abundant sweats which stain the skin yellow, even over the parts where there has been no exposure to the chemicals. There is intense thirst, the pupils are contracted, the patient is frightened and excited and there may be partial or general convulsions. This is followed by unconsciousness, coma and death in a few hours. It is the clinical picture of a fatal case of uremia. The symptoms in the severe cases which get well are much the same at first, but the second or third day shows marked improvement with rapid recovery. Some very rapid cases are described, developing while the workman was on his way home. He is found somewhere along the road, breathing with difficulty, covered with sweat, with a temperature of 41°C. or even 43°C. and he dies before anything can be done. Sometimes there is a rise of several degrees of temperature after death. Urine obtained by catheter shows an intense Derrien.

Perhaps the most interesting feature of the post-mortem examination is that no characteristic lesions are found. There may be edema of the lungs, at times a fatty infiltration of the liver, but the microscopic lesions in the liver and kidney cells are inconstant. The blood and organs always contain D.N.P. or its derivatives, but this is also true of the organs of workmen who die from accidental causes while employed on D.N.P.

It was supposed when the manufacture of D.N.P. was begun that the cases of poisoning which occurred among the workmen were due to impurities because the Service of Explosives had had long experience with picric acid and had had no trouble. Animal experiments, however, showed that all the impurities which it was possible to extract and all the compounds formed at various stages of manufacture, were less dangerous than the dinitrophenol 1–2–4. The animals tested were the horse, dog, rabbit, pigeon, turtle and frog, for all of which the toxic dose is 0.01 gram per kilo of animal. It is a specific poison, causing in all warm-blooded animals an exaggeration of the heat radiation activities, as shown by a thermic polypnoea in the dog, vasodilatation and sweating in the horse, with progressive elevation of the temperature which may rise to 45° C. at death. The extreme dehydration of the tissues leads to a very early rigor mortis, with delay of decomposition of the cadaver. The basis of these phenomena is an increase of combustion, which is not the result of a stimulation of the nervous system, for it occurs even in cold-blooded animals, has no relation to muscular work nor to any action on any special organ, but appears to be dependent on a general stimulation of cellular oxidation. In the blood and in the organs are found either the unchanged substance or its reduction products, the aminonitrophenols, and in the case of acute intoxication the amino-2-nitro-4-phenol is always present.

The administration of ortho or meta-mononitrophenol or of picric acid (trinitrophenol) gives none of the above results. Para-mononitrophenol and the 1–3–4 isomer of dinitrophenol do produce these results, but only transiently and in heavy doses. The other isomers have a very different effect, the 1–2–3 and the 1–3–5 cause the formation of methemoglobin. This indicates a very high specificity of dinitrophenol 1–2–4.

The protection of munition workers against this form of poisoning was based on the above studies and was directed to the prevention of contact with the poison, the elimination of the susceptible men, the detection of early symptoms, and the removal of those affected from work with D.N.P. Under the first head came important changes in the methods of manufacture, removal of dust and fumes, and substitution of mechanical for hand work. The medical supervision seems to have been very thorough, and the physician was always assisted by a laboratory technician who carried on routine Derrien tests. The workmen were provided with full suits of working clothes, including underwear, with wooden *sabots* and ankle pieces to prevent the dust from entering at the ankles. Abundant washing facilities were provided, and every effort made to make the men use them. In some places it was found possible to make the men bathe by paying an additional sum to the clean men. In another, it was necessary for the men actually to pass through a stream of warm water nearly up to the waist, with a shower going above in order to get to their street clothes. The results of these activities have been satisfactory and, while the records do not give the number of men exposed to the poison, a comparison can be made between the number of deaths per ten thousand manufactured tons in the year before these reforms were instituted with the number in the year following.

Period	Deaths	Tons of D N P and Mixture D D Manufactured	Deaths per 10,000 Tons
May, 1916, to May, 1917	31	19,100	16.3
May, 1917, to May, 1918	5	40,700	1.2

Picric acid was the favorite explosive in pre-war times but as the main supply was obtained from Germany, a new industry had to be built up. No serious effects were observed among the picric acid workmen and no cases of serious illness. Experiments showed that it required fully five times as much T.N.P. as D.N.P. to produce symptoms in guinea pigs. So little danger was there in the T.N.P. branch that it was used as a resting place for men who had to be taken away from contact with D.N.P. Mixed explosives were found to be dangerous in proportion to their D.N.P. content.

Trinitrotoluene was less used among the French than in England and America, although a good deal was made and loaded into shells. The operatives were no more cleanly than the English and Americans, yet in France the manufacture of T.N.T. is considered essentially safe. Only two cases of fatal toxic jaundice have been recorded and although it is possible that some may have been missed in the confusion of a war industry, the inquiries set up by the authorities in the case of death in a munition worker were very rigid. What is more significant is that the French insist that there was very little disability from T.N.T. sickness with loss of time among the workers, so that it was not considered necessary to have alternation of employment or special medical investigations. They believe that their method of purification by the use of sulphite, which removes the other isomers and tetranitromethane, is responsible for their escape from the troubles encountered in England and in the United States. Dr. Perkins notes in this connection the fact that since they have used sulphite purification in England there are far fewer cases of intoxication.

The results obtained in these various investigations led to a further series of studies of the various bodies used in the manufacture of explosives and the by-products, the two points studied being the minimum fatal dose and the relation of intoxication to vasomotor phenomena. It was found that the oil of dinitrotoluene and of dinitroxylene and the oils of trinitrated xylite are toxic. The fatal dose for the dog was for the first two, 0.5 gram per kg., for the last, 0.2 gram per kg. They produce important lesions of the liver and kidneys, have no vasodilating effects analogous to those of nitroglycerine, and their vapors when inhaled do not lead to a fall of arterial pressure. The chlor- and nitrochlorbenzenes are clearly less toxic than the nitrotoluenes, anisols and phenols. The most toxic compound of all is dinitrophenol 1 2 4, next the corresponding isomer of dinitranisol, then follow trinitrophenol, trinitranisol and dinitrotoluene 1 2 6, while the least toxic is chlorbenzene. Alice Hamilton.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Occupational Cancer. *D. Glibert.* Bull. Acad. Med. Belgique, May, 1919, 29, No. 4, 627–634. The writer relates the British researches and regulations about the pitch and coal-agglomerates industry. He shows that coal dust, naphtalin, creoline, and analin dyes do not produce any kind of skin phenomena. Certain kinds of pitch are also innocuous. If we have to reconcile the theory of arsenic poisoning with these facts, we must admit that the harmfulness does not lie in arsenic itself, but in the formation of some kind of arsenic compound which would be productive of cancer.

The author reminds us that H. C. Ross of the London Lister Institute did not find arsenic in pitch, and supposes that it contains some auxetic and kinetic substances which would be made harmless by adding a small proportion of formaldehyde. — René Sand.

Prophylaxis of the Pitch Disease. *M. Herman.* Bull. Acad. Med. Belgique, May, 1919, 29, No. 4, 599–606. — The writer describes the industrial preparation of pitch and of coal agglomerates. The pitch is reduced to small pieces with the pickax and transported to the grinding machine on a wheelbarrow. The ground pitch is mixed with coal dust, treated by steam and pressed into brick or egg-shaped agglomerates.

The only parts of the process which give rise to skin irritation are the crushing and grinding of the pitch, the pitch dust evidently being responsible. Pitch disease, tar disease and chimney-sweepers' disease are the same thing. There must be a common substance producing in those three classes of workers the same skin phenomena, which include boils, acne, eczema, warts and cancer.

Microscopic examination shows that the pitch particles are sharp, so their physical action is not negligible.

Prophylaxis must aim at preventing pitch dust from reaching the worker, which may be realized either by masks and special garments, or by crushing and grinding the pitch in closed machinery. — René Sand.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

The National Safety Congress. Am. Arch., Nov. 5, 1919, 116, No. 2289. — This is a brief discussion of the meeting of the National Safety Congress held in Cleveland, Ohio, October 1 to 4, followed by an abstract of Mr. Dresser's paper on *Co-operating on Safety.* — G. M. Fair.

Intensive Production and Accident Risks. Engin., Nov. 7, 1919, 108, No. 2810, 619–620. — The inauguration of the safety-first movement is believed to be responsible for the fact that despite the intense industrial activity, the hazard of lighting restrictions, the large numbers of persons employed

in dangerous industries, and the introduction of large numbers of "dilutees" into the working forces, the number of accidents recorded in some areas of Great Britain in 1918 was actually less than in 1914. This was notably the case in the Midlands where the total number of accidents reported was 35,706 in 1914; 29,556 in 1917, and 28,699 in 1919. This reduction is even more remarkable because there has been a steady tendency of late to class and report as accidents mishaps which in former years would have been regarded as insignificant incidents. But, although the total number of accidents was remarkably low, the proportion of serious or fatal casualties was higher than in pre-war times. There were 1,579 fatal accidents out of a total of about 164,000. Of this total about two-thirds were of a kind which would not be affected by regulations for fencing or other safeguards, and of the residue only a small fraction were attributable to the lack of preventive measures. The great majority of the accidents have arisen from the recklessness or ignorance of the operatives. For this reason some firms have organized safety committees consisting of representatives of the management and the men. By this arrangement and others of a similar character, one firm succeeded in reducing the number of accidents by 50 per cent. in the course of a single year.

Lead poisoning in Great Britain has dropped from 1,058 cases in 1900 to 144 in 1918, but the output was only 60 per cent. The manufacture of T.N.T. gave rise to 189 cases of poisoning in 1917, this number being reduced to thirty-four in 1918. Other interesting advances in accident prevention and health conservation have been made. — G. M. Fair.

Safety Engineering Reduces Cost of Construction. Engin. N.-Rec., Nov. 13–20, 1919, 83, No. 19, 864. — Accident prevention has proved highly profitable in the construction operations of the E. I. DuPont de Nemours Co. General statistics of expenses and savings due to accident prevention on two of these operations are given in a paper by F. L. Hurlbutt, safety engineer, before the construction section of the National Safety Council. During the period of organization of a department of safety the lost-time rate had steadily increased to 2.27 days lost per men per year. One month after safety activities had been begun in earnest this figure was reduced to 1.28 and in the following months to 0.744, 0.744, 0.684, 0.351, 0.441, and 0.216 respectively. The net saving effected by this control of accidents was $336,651, while the cost of maintaining the department was $50,000. — G. M. Fair.

Accident Prevention and Safety First. *Gerald Bellhouse.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 13–22. — Notices were received of 1579 fatal accidents, of 53,491 machinery accidents and of 108,663 nonmachinery cases. These figures represent enormous economic loss, and ways and means are considered for producing safer working conditions. These may be secured through regulations, trade agreements, safety committees, safety inspectors, and safety-first campaigns. Analysis of accidents to show in what manner they occurred is important. — Barnett Cohen.

Use of Electricity in Factories. *G. S. Ram.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 57–64. — In spite of the increased use of electrical power, there has been a reduction in the number of accidents due to electricity, though fatalities are somewhat increased. The importance of artificial respiration as a means of resuscitation in cases of apparent death from electrical shock is emphasized. — Barnett Cohen.

INDUSTRIAL SURGERY

Disability Following Injuries to the Back in Industrial Accidents. *James Warren Sever.* Jour. Orthop. Surg., Dec., 1919, 1, No. 12, 743–751. — A continuation of the article in the previous number of the same journal and abstracted in Industrial Hygiene, 1919, **1**, 148. This number contains tables of data on the cases discussed by Sever in the previous article. — C. C. Lund.

FATIGUE AND OCCUPATIONAL NEUROSES

The Problem of Fatigue. *Leonhard F. Fuld.* Ind. Management, Nov., 1919, 58, No. 5, 417–418. — The writer points out the value of proper nourishment in eliminating the drop in the production curve which manifests itself at different times of the day. He recommends that some simple form of nourishing food be provided during a mid-morning or mid-afternoon rest period. Excellent results have been obtained from milk, ice-cream, and soups. He also calls attention to the necessity for making available to workers for the mid-day meal nourishing food which can be obtained as an inexpensive supplement to lunches which they carry. — C. H. Paull.

Hours of Work. *R. E. Graves.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 2–12. — A detailed presentation of instances in British industrial plants of changes and reductions in hours of work and the resulting effect on output and morale. The general attitude of employers and workers is favorable to the changes made. Output has been maintained in many plants,

but not in all. Time-keeping has been vastly improved as a result, probably, of the better health enjoyed under the new conditions. The scheme for a five-day week does not seem to have worked out satisfactorily where tried. — Barnett Cohen.

Labour-Saving Appliances. *G. S. Taylor.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops, for 1918, pp. 23–27. — Extensive introduction of labor-saving devices in Great Britain has been due mainly to (1) the advent of women into many industries; (2) the necessity for economy of manual labor; (3) quantity production of articles the same size and of a form (like shells) which readily lends itself to simple mechanical methods of handling and transport. Many devices used in a number of industries are described from the standpoint of their efficacy in saving labor and reducing fatigue. — Barnett Cohen.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Mask and Protecting Garment for Welders. *Cammell Laird and Company.* Rev. d'hyg., July, 1919, 41, No. 7, 692–693. — Description of a protective mask with attached apron, used by the electric welders in a British shipbuilding establishment. — Wade Wright.

HEAT, COLD AND HUMIDITY

Air Control and the Reduction of the Death Rate after Operations. *Ellsworth Huntington.* Mod. Med., Oct., 1919, 1, No. 6, 463–468. — This paper discusses the correlation between various ailments and the humidity, temperature and variability of air. The optimum conditions for health and disease, and their effect on patients during and following operations, and on death rate are emphasized. — A. B. Emmons.

WOMEN AND CHILDREN IN INDUSTRY

Women Physicians and Women's Health. Survey, Nov. 15, 1919, 43, No. 4, 110–111. — This article contains the resolutions adopted by the First International Conference of Medical Women. Among the noteworthy recommendations of these resolutions are those advocating that greater emphasis be placed upon the function of the physician in preventing disease; that maternity insurance be provided; that both children and adults should avail themselves of periodic physical examinations; that workers be provided with accident and sickness insurance; and that provision be made for sex education under appropriate conditions. — C. H. Paull.

The Enforcement of International Labor Standards Relating to Child Labor. *W. N. Swift.* Proceedings of the Academy of Political Science, July, 1919, 8, No. 3, 100–102. — The adoption of international standards might compel our government to enter more seriously upon the work of education. Under state provision there is still a very unsatisfactory condition in regard to child labor and still great deficiency in provisions for continuation of the education of children who enter employment at the legal age. As the child labor law now stands, it is not at all certain that the national government can prevent even an inhumane exploitation of childhood or can enforce any proper standards. In North Carolina, for instance, children may still be employed eleven hours in a day and as late at night as 9 o'clock. — G. E. Partridge.

Westchester, What an American County Can Do. *Winthrop D. Lane.* Survey, Nov. 22, 1919, 43, No. 5, 140–143. — In discussing the unique work of Mr. V. Everit Macy as Commissioner of Charities and Corrections, the writer shows how effectively the work of the county psychiatric clinic has been co-ordinated with the care and placement of children in Westchester County. — C. H. Paull.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

The Pollution of the Atmosphere. Engin., Nov. 14, 1919, 108, No. 2811, 656–657. — The British committee charged with the investigation of atmospheric pollution have published their fourth report, together with the results of observations made in the year 1917–1918 at twenty-four selected stations in Great Britain. At Newcastle-on-Tyne the mean monthly deposit of the solids contained in the atmosphere was 20.81 metric tons per square kilometer. At Malvan the solids amounted to only 2.51 tons. Both stations increased the deposit in the summer months of 1916–1917 and diminished it in

the winter months. Generally there was a tendency at all stations for this to occur, but London showed an improvement in both winter and summer. It is important, however, to note that the sources of pollution differ considerably in the two seasons — in summer, dust forms the preponderating share; in winter, dust from fuels is the greatest source.

The deposit of carbonaceous matter was less during the summer months; insoluble ash showed a great increase during the summer and a slight increase in the winter. Sulphates mainly derived from combustion products decreased in summer and increased in winter; chlorine deposit was the same for both seasons. Malvan had the lowest deposit of all elements of pollution, and, curiously enough, the second lowest in seven cases out of nine was Wandoworth Common, London. — G. M. Fair.

Atmospheric Pollution. Science; Nov. 28, 1919, 50, No. 1300, 501. — This is an abstract of the fourth report of the British Advisory Committee on Atmospheric Pollution. — G. M. Fair.

The Relative Sanitary Values of Different Types of Drinking Fountains. Part I. The Results of Tests of Vertical-Nozzle Types. *Louis V. Dieter.* Am. City, Nov., 1919, 21, No. 5, 452–457. — After nine or ten years of uninterrupted popularity, the bubble fountain was found upon investigation to be a menace to the public health fully as much as the common drinking cup. Mr. Dieter, who has made very complete laboratory tests upon a great many types of so-called sanitary drinking fountains, gives the results of his experiments in this paper. His experience with the vertical-nozzle type fountain shows that none of the more or less intricate internal arrangements for swirling the water or allowing it to come from the nozzle in various fancy ways will protect the drinker, unless the guards are so constructed that it will be impossible to touch the nozzle either with the mouth or with the fingers, and unless it is equally impossible for drippings from the mouth to fall back on the nozzle. None of the fountains examined possessed these features. — G. M. Fair.

The Essential Features of Sanitary Plumbing Fixtures. Am. Arch., Oct. 22, 1919, 116, No. 2287, 535–537. — This article discusses in detail the construction of plumbing fixtures and their placing in buildings. The weak links of present practice are pointed out and improvements are suggested, notably for the connection of earthenware floor fixtures to the drainage system. — G. M. Fair.

MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Keeping Workers Well. Factory, Dec., 1919, 23, No. 6, 1316–1326. — Pages 1324 and 1326 of this collection of short contributions contain three suggestions of ways by which convalescent workers can be given duties in keeping with their physical condition. Among such duties are light work around the plant, and work which they can do in their homes. Not only does this make the man a producer again, but it frequently helps him through a period of inactivity when discouragement is apt to overcome him. — C. H. Paull.

INDUSTRIAL, PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Town Planning in Relation to Industrial Development. *C. W. Kirkpatrick.* Canad. Engineer, Dec. 11, 1919, 37, No. 24, 524–525, 531–532. — The industrial commissioner of Hamilton, Ontario, believes that housing and working efficiency go hand in hand; indeed, that a study of the housing of the particular labor in which the manufacturer is interested will enable him to decide whether he will be able to obtain efficient labor or not. It is quite possible by logical planning for an industrial city to be both beautiful and comfortable. — G. M. Fair.

City Hygiene in Relation to Employment. *W. J. Howarth.* Jour. Roy. San. Inst., June, 1919, 39, No. 4, 133–142. — The author points to the large number of physically subnormal persons in large cities. Some of the causes discussed are atmospheric pollution with street dust and gases, sedentary occupations, lack of exercise and inadequate ventilation of rooms. These conditions result in absence from work and reduced capacity, if not severe illness. Street disinfection is at present a *placebo.* Flushing of streets and the substitution of gas and electricity for coal are suggested as means of improving the air. Factory conditions are faulty, largely through carelessness of those responsible for cleaning and ventilating, although some structural defects exist.

The increased employment of women and young persons requires increased attention to sanitation. Persons newly entering city work fail to assume suitable, dry attire and to eat proper meals; they adapt themselves with difficulty to monotonous labor. Education through publicity under expert dietitians and hygienists should furnish the needed knowledge. A common room and suitable recreation would help solve the problem of monotony. The sanitary problems created by restaurant kitchens, especially basement kitchens, underground workrooms, lock-up shops and kiosks are discussed. — A. B. Emmons.

France's First City Planning Law. *Frank Backus Williams.* Nat. Munic. Rev., Oct., 1919, 8,

No. 8, 535–537. — A brief review and discussion of the recently enacted municipal planning law of France. The writer compares this law with similar laws in other European countries. Among the important features of this law are its provision for the consideration of health and artistic elements in city plans which communities shall draw up for approval. — C. H. Paull.

Hygienic Survey of the Garden City of Staaken near Spaudau. *Johanna Nitsch.* Ztschr. f. Hyg. u. Infektionskrankh., 1919, 88, No. 3. — An illustrated article giving a description of a newly constructed residence community built by the state for workers in the war industries of Spaudau. The village is entirely residential. The ground was secured, the village laid out and the houses, etc., built by the " Reichsamt des Innern " and then turned over to an association of householders which pays a 2 per cent. rental to the state. Each holder subscribes to shares to the value of 300 marks, which may be paid in monthly installments, and pays a monthly rental of from 22 to 45 marks. Sixty-five per cent. of the holders must be government employees.

The village is built at present to accommodate 846 families, or 3500 persons, with an allowance of 300 extra roomers. The houses are, in the main, well planned and the village well laid out and is considered as a distinct advance in industrial housing. A number of details are found faulty, however, and some are severely criticized. There are 298 single houses built in rows and 146 apartment houses containing accommodations for three or four families. Each tenant has a garden space, usually in the rear of his house, of 100 to 200 square meters. There is a central water supply with running water for each house, and a general sewage disposal plant of settling tanks for the entire village. There are two schools, several stores and an unfinished church. Houses are one or two stories with rooms 2½ meters high. They are lighted with electricity and heated by porcelain or iron stoves, with porcelain stoves or gas stoves for cooking. Single houses have a kitchen, washroom, storeroom, and two bedrooms; apartments have a kitchen, two bedrooms and a washroom for every four apartments. Bath tubs are supplied in the houses but are little used for the purpose for which they are intended. The kitchens are used as family living rooms. The principal criticisms are as follows:

Some streets are too wide for small houses, thereby wasting land, producing too much dust, requiring too much care, and being poorly lighted at night.

The trees are planted too close to the houses.

There is an absence of seats or benches in front of the houses, and an entire absence of provision for children's playgrounds, with the result that the streets are used for this purpose.

There are no curbs, no gutters for rain water, and no sidewalks, making some of the houses virtually islands in heavy rains.

The absence of cellars under about one-half of the single houses results in many damp rooms.

There is poor lighting in many rooms and in others the windows are arranged to give light but do not furnish sufficient ventilation. — H. F. Smyth.

California's Labor Camps. *Christina Kryst.* Survey, Nov. 8, 1919, 43, No. 3, 70–78. — An excellent account of the activities of the California Commission of Immigration and Housing in changing conditions in labor camps. The writer calls attention to conditions which have existed quite generally in the past in labor camps in California. As an instance, she cites the case which developed into the Wheatland hop-field riots in 1913. On the ranch where these riots developed, men, women and children were living practically in the open. Disease spread as a result of almost complete lack of sanitary provisions; even wholesome drinking water was very scarce. The Commission from its creation in 1913 developed its work primarily as an educational project, and while its activities were later given greater legal support, the aim of " selling " its work to ranch owners and to workers has never been lost sight of.

Up to the present time the Commission has been able to establish in permanent, temporary, and community labor camps conditions of housing and sanitation which have not only tended to stabilize labor but which have raised the social standards of many of the labor camps. Rain and fly-proof tents or living houses, sanitary toilets, shower baths, and an awakened interest in education and wholesome entertainment followed in the wake of the Commission's representatives. — C. H. Paull.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

A Classified Scale for Measuring Intelligence. *C. W. Washburne.* Jour. Educational Psychology, Sept., 1919, 10, No. 7, 309–322. — The writer of this paper has tried to overcome the failure of the current intelligence tests to indicate special deficiencies and abilities, by grouping the tests of the Stanford revision of the Binet system according to the predominant function or functions used in passing them, thus making the scale specifically diagnostic as well as a measure of general intelligence. The procedure and scoring are identical with those of the Stanford method, so that the intelligence quotients found are comparable with the standards in use. The tests have been arranged in seventeen groups, the rubrics following a practical rather than a strictly analytical grouping. Details are given for scoring. The writer maintains that sufficient trial has been made of the method to show that by it one can readily detect special qualities of intelligence. — G. E. Partridge.

A Preliminary Report of Some Group Tests of General Intelligence. *Frances Lowell.* Jour. Educational Psychology, Sept., 1919, 10, No. 7, 323–344. Although these tests are especially adapted for use with children, the paper contains some relevant discussion of the general use of group tests. Some of the tests used have been selected from those of Binet, Kuhlmann and Terman; the others are new. Their main purpose is to serve as a means of selecting cases of doubtful mentality to be subjected later to individual examination. — G. E. Partridge.

An Abbreviated Mental Age Scale for Adults. *E. A. Lincoln* and *K. M. Cowdery.* School and Society, Dec. 13, 1919, 10, No. 259, 707–709. — The abbreviated mental age scale described here was devised to meet special requirements found in examining men in the army. Thirteen tests were selected from the Stanford series which were believed to have greater diagnostic value than the rest. By the use of this series the examiners were able to double the number of their examinations. The writers suggest that their method may be useful in the application of intelligence tests to industrial groups in cases where rapid individual examinations seem desirable. Tables are presented showing results by these tests as compared with the results according to the Stanford series. — G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

Adult Recreation. Playground, Dec., 1919, 13, No. 9, 414–420. — The experiences of War Camp Community Service and other national and local agencies in developing recreational and social activities during the war period have re-emphasized the value of recreation for adults and have suggested new possibilities. The article contains a useful outline of community recreations and of both outdoor and indoor recreations for adults, with a special list of activities for adults in rural communities. — G. E. Partridge.

Outdoor Industrial Theatres. *Constance D'A. Mackay.* Playground, Dec., 1919, 13, No. 9, 433–437. — To plan recreation for our foreign-born workers in great industrial cities is a difficult and important problem. One solution is the outdoor industrial theatre, established in the center of each foreign section. The cost of these theatres is very small, even if permanent structures are built. Some practical details are given, and the bearing of the subject upon the problem of the Americanization of the foreign population is discussed. — G. E. Partridge.

Recognizing the Commercial Value of Music. National Association of Corporation Schools Bulletin, Sept., 1919, 6, No. 9, 399–404. — This study, made by questionnaire by the director of the National Association of Corporation Schools, reports returns from eighty companies, all nationally prominent. Of these, sixty-three maintain a musical, dramatic, dancing or other form of social organization; twenty-three have choral societies; thirty-one maintain bands; and twenty-two have orchestras. Dancing and dramatic clubs come next in interest among the industrial recreational enterprises. Six companies occasionally feature moving pictures, and about as many support literary and debating societies. There is almost unanimity of opinion in regard to the value of each of the forms of recreation mentioned. More attention is given in the paper to the question of support of recreations than to the hygienic aspects of the problem, but the discussion is suggestive. — G. E. Partridge.

WORKMEN'S COMPENSATION AND INSURANCE

The Explosion of Chemicals. I. Common Law Liability. *Chesla C. Sherlock.* Abstracted from Chem. Met. Eng., 1919, 21, 83–84, by C. E. Munroe in Chem. Abstr., Sept. 10, 1919, 13, No. 17, 2129. — "The legal liability of an employer for injuries caused to his workmen by explosions of chemicals with which they are required to deal must necessarily divide itself into two classifications: (1) common law liability and (2) workmen's compensation acts. . . . The principles which apply under the common law are stated and illustrated by many citations from specific cases." — W. O. Fenn.

The Explosion of Chemicals. II. Workmen's Compensation Acts. *Chesla C. Sherlock.* Abstracted from Chem. Met. Eng., 1919, 21, 131–132, by C. E. Munroe in Chem. Abstr., Oct. 10, 1919, 13, No. 19, 2418. — The origin of the compensation acts as a result of abuses of common law liability is described and the underlying principles are defined. "The accident causing the injury must arise out of and in the course of employment. The workman is not entitled to compensation if the accident results from his serious and wilful misconduct, his meddling with work which is not his own, horseplay, or the malicious intent of another." — W. O. Fenn.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

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GENERAL

A Comment on the Question of Spreading the Knowledge of Hygiene among the Public. *Springer.* Deutsch. med. Wchnschr., Oct. 2, 1919, 45, No. 40, 1112. — In the new legislation regarding workmen's councils, it is provided that they shall combat industrial accidents and diseases by giving suggestions, advice and encouragement, and if necessary by process of law. They are also given a hand in altering the factory regulations and in introducing new processes when desirable. These workmen's councils will be in a much better position to observe and to enforce safety regulations than are factory inspectors; but they should include a few doctors, and the lay members should have instruction in industrial and general hygiene. To provide this instruction, some of the mining companies are providing special courses for the members of the council, not only upon the hazards of that particular industry but also upon general health measures. — T. J. Putnam.

The Health Problem from a New Angle. *J. F. Williams.* Educational Review, Jan., 1920, 59, No. 291, 46–57. — "Because man is to be considered as evolving toward a more rational life in which no instinctive urge will achieve the usual, the traditional and static responses, the whole health problem must be reconsidered and approached from a new point of view. The history of hygiene shows how stupid and awkward we have been. We have thought to deal with personality by tooth-brush drills and medical inspection, by prophylaxis and punishment, when the very source of all hygienic action, so far as meeting the crises of life is concerned, was the conscious and motivated intelligence of the individual. The problems of health in the individual cannot be met by mere checks on disease alone, or by information on the dangers imminent: indeed, national health presents the same situation. There must come virile motives for attaining a fine end, motives that are rationalized and conscious.

For some time, perhaps always, there will be need for adequate machinery in government to accomplish certain state and regulatory procedures." — G. E. Partridge.

For the Health of the Holy Land. *I. M. Rubinow.* Survey, Nov. 29, 1919, 43, No. 6, 175–178. — The writer gives an account of the work of the American Zionist Medical Unit in establishing medical service in various parts of Palestine. Through the untiring efforts of the organization of which he is the director, order is gradually growing out of the chaos of ruin and disease which the war left in its wake. By the end of April, the unit was operating hospitals in Jerusalem, Jaffa, Safed, and Tiberias with clinics in these cities and in Haifa, Hebron, and Jericho. One of the interesting features of the activities of the American Zionist Medical Unit is that, because of its ability to render service to all classes, it has paved the way for the extensive development of socialized medical service in Palestine. — C. H. Paull.

Why Overhauling of the Human Machine is Necessary. *S. D. Hubbard.* Month. Bull., N. Y. City Dept. Health, Nov., 1919, 9, No. 11, 262–271. — The author urges that the same attention which we give to perfection of the industrial machine be devoted to the attainment of an equal degree of perfection in the human machine. To produce the highest degree of efficiency which may be secured from the human machine, the following suggestions are offered: Applicants for employment must be carefully examined with a view to the type of work to be performed; workers must be supervised, not only to detect loafing or vicious habits, but also to see that they are efficient and that the labor is not causing wear or maladjustment of the human machine. The above policy would promote production as a result of the reduction of human sickness and misery.

A table is appended showing the industrial field examined, the individuals held on probation, the exclusions for infectious diseases, and all other diseases detected. — L. A. Shaw.

Sickness Records for Industrial Establishments. U. S. Pub. Health Ser., Pub. Health Rep., Nov. 14, 1919, 34, No. 46, 2593–2604. — Neither the factory manager, employees' organization nor public health agency are able to control or prevent disease unless the records of the conditions conducive to sickness are kept, not intermittently, but continuously.

Industrial establishments, employees' organizations, and public health agencies have spent large sums of money on general principles and on wholesale sanitation; whereas all such activities should be based upon definite information and regarding the where, when and how of disease occurrence.

A practicable standard plan for reporting and recording sickness was presented by a special committee to the American Public Health Association in October, 1918. With the assistance of this committee and of others, two plans for the recording and reporting of disease prevalence among workers were finally formulated. These plans are herewith presented, with an invitation from the Public Health Service to all industrial establishments or employees' sick benefit associations to correspond and cooperate with the Statistical Office. — L. A. Shaw.

Defects Found in Drafted Men. *C. B. Davenport* and *A. G. Love.* Scientific Monthly, Jan., 1920, 10, No. 1, 5–25. — The study is based upon data recorded in the office of the Provost Marshal General and the Surgeon General of the Army. A complete survey of the defects in the American population would be of importance for many interests; among its services would be that of giving insight into the suitability of the population for the various occupations which our social organization requires. In the total population examined during the war (2,740,000 men), 468 men in every 1000 were found to be defective. Of the defects found, 39 per cent. were of a mechanical nature, defects of bones and joints, and the like; 12 per cent. were of the sense organs; 11 per cent. were from tuberculosis and venereal diseases; 10 per cent. were from cardio-vascular diseases; 10 per cent. were defects of developmental and metabolic processes; and 6 per cent. were nervous and mental defects. There were more than 300,000 cases of weak feet, and more than fifty men in 1000 were found with hernia. Of the nervous and mental defects, mental deficiency was most frequent, being discovered in 40,000 men by the medical examiners — many more being found subsequently by the psychologists. In all, about 12 per cent. of the men examined were rejected for all military service.

The larger part of the article (which is to be continued) is devoted to a study of the geographical distribution of defects. There are seventeen maps, presenting the exceedingly interesting and important results of the study. — G. E. Partridge.

The National Importance of Scientific and Industrial Research. *G. E. Hale, E. Root, H. S. Pritchett, T. N. Vail, A. Swasey, A. W. Mellon, G. Eastman, W. Douglas, J. R. MacColl, H. E. Howe.* Bulletin of the National Research Council, Oct., 1919, 1, No. 1, 1–43. — These papers emphasize the fact that throughout the civilized world the national importance of science and research is appreciated as never before. Many tendencies of the time indicate both the opportunity and the necessity for further effort. There is not a little pseudoscience. Many industries are conducted on purely empirical lines without the enormous advantages that scientific methods would bring. There is need of organization, of a high standard of scientific research, and of a closer and more fruitful relation between the research man in the university and the industrial plant. It is pointed out that the work of the scientist has in some cases already made it possible for thousands of men to produce a quality of work that only a few years ago could be reached only by a few especially trained individuals — one instance being the development of the pyrometer. The

longest paper in the series, by H. E. Howe, is a summary of reports on the organization of scientific and industrial research at home and abroad. — G. E. Partridge.

Draft Conventions and Recommendations Adopted by the International Labor Conference of the League of Nations. Am. Labor Legis. Rev., Dec., 1919, 9, No. 4, 529–538. — See also The New Labor Code of the World, Survey, Dec. 20, 1919, 43, No. 8, Section II; and International Labor Conference Draft Conventions, Recommendations and Resolutions, Am. Industries, Dec., 1919, 20, No. 5, 21–23. — Of the three articles mentioned, the one in the Survey includes a list of the names of the delegates with their status. Article II of the draft convention limiting the hours of work in industrial undertakings provides for an eight-hour day with a forty-eight-hour week. Exceptions to this provision are enumerated in Articles III and following.

The draft convention concerning the employment of women before and after childbirth excludes women from employment during the six weeks following confinement, and gives them the right to leave work six weeks prior to that time. Women are also to be provided with maternity support.

Two of the draft conventions prohibit night work for women and for young persons under 18 years of age except in certain specified instances.

A minimum working age for children of 14 years is established in another convention.

Special recommendations are made regarding employment where the worker is exposed to industrial poisoning or disease.

The six draft conventions of the International Labor Conference are subject to ratification by the nations within the International Labor Organization. The recommendations are submitted with the view that they will be considered in connection with national legislation. — C. H. Paull.

The International Labor Conference at Washington. Am. Industries, Dec., 1919, 20, No. 5, 12–20. — This is a brief account of the proceedings of the conference showing, day by day, the business transacted. For those desiring to inform themselves concerning the reasons for specific clauses in the conventions, recommendations, and resolutions as finally adopted, the brief reports of discussions will be found helpful. — C. H. Paull.

Capital Gets a New Director. *E. Wildman.* Forum, Dec., 1919, 539–550. — This is a popular account and discussion of the movement made by the Procter and Gamble Company toward democratization of their business by accepting on the board of directors a representative elected by the employees. "It was the first time in American industry that the employees, whether stockholders or not, were able to secure the direct representation of one of their number on the board of directors of a concern for which they worked." — G. E. Partridge.

The Constitution of the German Republic and the Medical Profession. *Otto Mugdan.* Deutsch. med. Wchnschr., Aug. 28, 1919, 45, No. 35, 973–974. — The constitution adopted by the National Constitutional Assembly is divided into two parts. The first deals with the structure and administration of the nation, the powers of the Reichstag and Reichsrat, of the president, and so forth. The second defines the fundamental rights and duties of the people. Many powers and privileges are transferred from the several states (Länder) to the national government; postal and telegraph systems, and many railroads and canals are nationalized. The federal government is empowered to oversee the execution of its laws by the local officials, and to supplement or supplant these officials with its own, if necessary.

The nation has, among other things, legislative power over repopulation, mothers' and children's welfare, public health, and traffic in provisions and public utilities. These are affairs which so far have been largely under local control. The necessity for the establishment of a national health service is a result of the need for greater efficiency and economy, and it is only a question of time when medical service will be entirely administered by the federal government.

The two legislative bodies, the Reichstag and the Reichsrat, are mutually limited, and both are further limited to some extent by the president's decisions. This rather complicated organization makes the need for a centralized ministry of health all the more pressing, in the first place as an impartial advisory body on public health matters, and in the second as an institution that can act quickly in time of need without waiting for legislative action.

Honorary titles, orders, and medals, with the exception of those conferred for services during the war, are forbidden in medicine as elsewhere. — T. J. Putnam.

Disciplinary Problems of the Army. *Herman M. Adler.* Ment. Hyg., Oct., 1919, 3, No. 4, 594–602. — At the outbreak of the war it was estimated that an army of 3,000,000 men would require provision for about 50,000 prisoners at the Disciplinary Barracks. Instead, only 5,000 prisoners were received, or 10 per cent. of the estimated number based on previous experiences. This can be explained on only two grounds: first, the enforcement of prohibition; and second, the elimination, through the work of the neuropsychiatric officers, of low-grade defectives and psychopathic men before they really entered the military service. — S. Cobb.

Disciplinary Problems of the Navy. *A. L. Jacoby.* Ment. Hyg., Oct., 1919, 3, No. 4, 603–608. — "If the navy is regarded as a large organization, with a definite function to accomplish, then it behooves us to conserve the usefulness of the members of the organization as far as possible, for the benefit of the navy, and eliminate those who are a constant expense. From the cases we have studied we find that about 50 per cent. of them are men of whom it

was easily demonstrable that they were either nervously or mentally not fit for the service, and as two-thirds of our cases are men who find themselves in the Naval Prison less than one year from the date of their enlistment, it is reasonable to suppose that these men were also unfit when they enlisted. Therefore, the best single point of attack to the navy's prison problem is at the recruiting office, and it falls upon the shoulders of the medical officer. Unfortunately, our state of knowledge is not so perfect that we can eliminate delinquents at the recruiting station by means of a yard stick or other instrument of precision, but the taking of a short social and medical history at the recruiting station will eliminate most of the undesirable types." — S. Cobb.

A New School for Managers for our National Industry and our Commerce in France and Abroad. *H. Schoen.* Revue internationale de l'enseignement, Jan.-Feb., 1919, 73, 66–73. — Describes a special school of commercial and administrative sciences recently established. — G. E. Partridge.

Continued Education. Journal of Education and School World, July, 1919, 51, No. 600, 436. — The Labor Party's Advisory Committee on Education (England) has recently issued a booklet dealing with the subject of "continued education," as provided for by the new Education Act. The primary object of the new continuation schools should not be, the Committee insists, to impart specialized industrial and commercial education, but to give boys and girls a general education. — G. E. Partridge.

Is the Long Summer Vacation Necessary? *H. J. Fenton.* Educational Review, Jan., 1920, 59, No. 1, 41–45. — The writer doubts that the long vacation, now almost universal for educational institutions, is necessary, and points out the fact that no other institution is conducted on this plan. Two schools, the Naval Academy and the Military Academy, are practically all-the-year-round schools, having an intensive life at all times, and yet maintaining a high standard of health and efficiency. — G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT, AND PREVENTION

MENTAL

General Psychopathology. *E. E. Southard.* The Psychological Bulletin, June, 1919, 16, No. 6, 187–199. — This is a summary of recent literature on the psychoses and neuroses of the war, with special reference to shell shock. A bibliography of forty-five titles is included. — G. E. Partridge.

Mental Defect in a Southern State. *V. V. Anderson.* Ment. Hyg., Oct., 1919, 3, No. 4, 527–565. — This paper is the report of the Georgia Commission on Feeblemindedness and the survey of the National Committee for Mental Hygiene. Its industrial interest lies in the exposition of the methods employed to detect feeblemindedness, and the relationship of feeblemindedness to pauperism, dependency, crime, vagrancy and the like — problems of importance to employment managers. — S. Cobb.

Shell-Shock Analogues: Neuroses in Civil Life Having a Sudden or Critical Origin. *Mary C. Jarrett.* Bulletin of the Massachusetts Commission on Mental Diseases, Jan., 1919, 3, No. 1, 59–73. — There are here fifteen case histories, mainly of protracted mental complications following physical shock or definite trauma. The cases have a general interest for those who must clarify the concept of shell shock, and the industrial physician will find some data that may be useful. — G. E. Partridge.

The Neurosis of the Housewife. *A. Myerson.* Bulletin of the Massachusetts Commission on Mental Diseases, Jan., 1919, 3, No. 1, 45–54. — The writer presents a composite picture of the effects of the total of home cares and housework upon a certain type of mind. He thinks there is a typical result under conditions very frequently found, especially among the poor. The central emotion or mood of the state is anxiety with hypochondriacal symptoms and a widely varied subjective manifestation in the form of pains and ill-defined distress. The causes mentioned are: the monotony and gradual fixation of home life in depressive and uninspiring routine; retirement of husband and wife, after a few years, into worlds having little in common; excessive indoor life; irregular habits of eating; poverty — both on account of the physical hardships it brings and because of the inhibition of many desires; conflict with the husband in regard to authority in the house; and, finally, the conflicts that occur in the sexual life — ill-matedness, fear of pregnancy, resentment at the implication of possession. The crux of the whole disturbance that ensues rests in the emotional life. There are different types. The thoroughly selfish woman gains relief in her own pleasures. The strong woman adjusts herself to conditions. The peasant type gains contentment from a minimum of satisfactions. But very many women have more feeling than capacity for adjustment. The characteristic result is a neurosis in which there is inability to know how to act. Many can neither accept nor reject their life conditions, and so there is wanting a fundamental and necessary attitude for mental health, a fixed viewpoint. In the background of the neurosis is a doubt. A great many of these women are not neuropathic constitutionally. There is a native temperament that is good and normal, but merely not adapted for a very hard and unsatisfactory life. The cure lies in the removal of the unfavorable conditions and in learning to make mental adjustment. — G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

The Determination of Carbon Monoxide in Blood. *Donald D. Van Slyke* and *Harald A. Salvesen.* Jour. Biol. Chem., Nov., 1919, 40, No. 1, 103–107. — A method is described for the gasometric determination of carbon monoxide in blood. The same apparatus which has been previously described by Van Slyke for determination of oxygen and carbon dioxide is used. The oxygen and carbon monoxide are set free from the hemoglobin by ferricyanide, the oxygen is absorbed in the apparatus by alkaline pyrogallate, and the remaining carbon monoxide is measured directly at atmospheric pressure, making the necessary correction for the nitrogen dissolved in blood. Only 2 c. c. of blood are required for a determination which may be finished in from ten to fifteen minutes. — A. S. Minot.

DUST HAZARDS AND THEIR EFFECTS

Health Hazards of Non-Poisonous Dusts — A Résumé of Some Recent Investigations. *Emery R. Hayhurst.* Am. Jour. Pub. Health, Jan., 1920, 10, No. 1, 60–65. — Among the conclusions which the author draws are the following:

Some 5,000,000 persons, or 10 per cent. of all workers, are subject to the health hazards of non-poisonous dusts in the United States.

With any type of dust, duration of exposure, amount actually inhaled, non-protective physiology and anatomy of the individual, with stress on lack of personal hygiene, are all-important points.

Improvements in estimating the amounts of dust in the atmosphere breathed and the amounts and character of foreign matter in the lungs have thrown much light on the dangerous nature of inhaled dusts.

The body defenses against dust, while intricate and subject to wide variations, are becoming better understood and appreciated, and are wonderfully efficient if coupled with a reasonable amount of practical hygiene.

The amount of dust accumulation in the lungs seems controllable by keeping the rates of invasion below the rates of elimination and, with these things known or ascertainable, it begins to appear as though a scientific basis is near at hand for estimating the maximum amounts of dusts permissible in the breathing atmosphere, and the proper modifications or admixtures of otherwise uncontrollable dusts that will render them comparatively harmless. — H. F. Smyth.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Campaign Against Tuberculosis. Health Bull., North Carolina State Board of Health, Dec., 1919, 34, No. 12, 5–23. — In this issue there appear seven articles dealing with the campaign against tuberculosis conducted by the State Board of Health of North Carolina. These articles appear under the following titles: Tuberculosis Work by the Whole-Time County Health Officer in Coöperation with the State Board of Health; How to Prevent the Spread of Tuberculosis; Rest, the Main Essential; The Sputum and the Germ; Occupational Therapy — Vocational Education at State Sanatorium; The Sanatorium Clinics; The Proper Organization for the Fight against Tuberculosis for a Town and County; and Unit of Tuberculosis of State Board of Health. — L. A. Shaw.

The Tuberculosis Problem. *A. G. Young.* Bull. Maine State Dept. Health, Oct., 1919, 2, No. 10, 169–190. — A statement of the policy of the State Department of Health of Maine in the treatment and prevention of tuberculosis. — L. A. Shaw.

Tuberculosis in New York City During 1918. *Louis I. Harris.* Month. Bull., N. Y. City Dept. Health, Oct., 1919, 9, No. 10, 233–248. — This article considers the cases of tuberculosis in New York City during 1918 under the following heads: tuberculosis cared for in institutions; homeless and lost cases; supervision of home conditions of patients; cases under care of private physicians; department clinic cases; and out-of-town cases. The activities of the tuberculosis clinics of the Health Department and of the day camp tuberculosis preventoria are enumerated. Tables are appended giving data of work performed by the tuberculosis clinics, applicants for examination, general status of tuberculosis in New York City during 1918, etc. — L. A. Shaw.

Tuberculous Residents of New York City Need not be Sent West for Cure. Week. Bull., N. Y. City Dept. Health, Nov. 29, 1919, 8, No. 47, 377–380. — The widely prevalent practice of sending tuberculous patients with limited financial means to western cities for supposed climatic advantages is here shown to be pernicious. In all but exceptional cases, the faith in climatic treatment has been proven to be erroneous. The lack of charitable aid, of adequate medical assistance, of employment, and of the care of friends and relatives only tends to aggravate the general condition of the patient. Home treat-

ment combines all the physical essentials for treatment which may be found in the western sanatoria, and comprises inestimable advantages which are denied to the patient living in exile. — L. A. Shaw.

A Factory for the Tuberculous. Survey, Dec. 13, 1919, 43, No. 7, 230–231. — An account of a unique scheme for offering work in proportion to the strength of those affected with tuberculosis. As soon as a patient is sufficiently strong to undertake work, he is allowed to work in this New York factory for the number of hours per day which a careful physical examination determines as desirable. The work is garment making. The factory is operated on a paying basis, and the average wage is $25 per week. During the entire working day each person is subject to special rules of hygiene, rest and diet. By this scheme, the convalescent is able to work within the limits of his strength and contribute toward the support of his family. — C. H. Paull.

Today's World Problem in Disease Prevention. U. S. Pub. Health Ser., Pub. Health Rep., Nov. 28, 1919, 34, No. 48, 2715. — "The United States Public Health Service has recently published a 136-page book on venereal diseases, entitled *To-day's World Problem in Disease Prevention.* It is a popular, non-technical discussion of syphilis and gonorrhea by Dr. John H. Stokes, Chief of the Section of Dermatology and Syphilology of the Mayo Clinic, Rochester, Minn.

"A limited number of copies of this book are now available, and until the supply is exhausted a copy will be sent to anyone who can use it advantageously. Applications should be made by letter addressed to the Surgeon General, United States Public Health Service, 228 First Street, N. W., Washington, D.C." — L. A. Shaw.

The Public Health Service Campaign Against Venereal Diseases. *C. C. Pierce.* Soc. Hyg., Oct., 1919, 5, No. 4, 415–439. — Herein is given the plan of co-operation between the United States Public Health Service and the state Boards of Health as adopted in January, 1918, for the control of venereal diseases. — L. A. Shaw.

Suggestions for Community Action Against Venereal Disease. *Dana L. Jewell.* Soc. Hyg., Oct., 1919, 5, No. 4, 497–519. — As a result of the campaign of the federal government against venereal disease during the war, numerous community committees under various names have been organized in the hope of perpetuating the effort and of making the good results permanent. In order that such committees may unite the various shades of public opinion, they must be very careful not to confuse the moral issue with the health issue. The moral aspect of the venereal disease problem is certain to excite antagonism and thus destroy co-operate action; whereas action based upon a health basis presents none of these conflicting elements. — L. A. Shaw.

The Treatment of the Venereal Disease Patient. *H. E. Kleinschmidt.* Soc. Hyg., Oct., 1919, 5, No. 4, 533–538. — This article treats of the organization of venereal disease clinics with especial reference to privacy and the general morale of the relations between the clinical personnel and the patients. Both privacy and modesty are essential if the patient is to be held until cured. The education so vital to the prevention of venereal diseases will be impossible unless the relation between doctor and patient is maintained at a high standard. — L. A. Shaw.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Memorandum on Cutting Lubricants and Cooling Liquids, and on Skin Diseases Produced by Lubricants. Department of Scientific and Industrial Research, Bull. No. 2, London, 1918, pp. 8. — Part I of this pamphlet deals with cutting lubricants and cooling liquids, the selection of cutting lubricants, and their physical and chemical points of interest. Part II, which deals with skin diseases produced by lubricants, we quote in full.

Skin Diseases Produced by Lubricants

"1. Oil rashes are, generally speaking, of two kinds — the first is due to plugging of the small glands at the root of the hairs on the arms and legs of workers, the second to mechanical injury to the skin produced by metallic particles suspended in the cutting lubricant.

"(a) *Plugging of the Glands of the Hair Follicles.*

"Primarily this is purely mechanical; a mixture of oil and dirt blocks the minute openings of these glands and sets up inflammation round the hair (folliculitis). The inflammation commenced in this way may lead on to suppuration or abscess formation (a boil). If many hairs are affected the arm presents an appearance of a crop of raised red spots (papules), with a black spot as a centre, or, if the inflammation has gone as far as suppuration (abscess formation), a yellow head.

"(b) *Mechanical Injury to the Skin by Metallic Particles.*

"Minute metallic particles suspended in the cutting lubricant may produce injury to the skin. This occurs chiefly on the hands, where two surfaces are rubbed together, *e. g.*, the skin between the fingers. Injury to the skin may also be produced on any part of the hands and arms by wiping with a cloth or rag while the hands or arms are coated with a film of fluid in which metallic particles are suspended. Injury to the skin allows germs to enter and causes septic infection.

"2. *Prevention.* — (a) *Cleanliness of the Worker.* — Washing accommodation for workers in contact with oil must be on a liberal scale. Hot water, soap, and scrubbing brushes are essential. Workers should

be instructed not to wipe their hands on rags, etc., before washing and to avoid washing their hands in the cutting compounds.

"Ether soap, which dissolves oil, has been found useful in preventing inflammation of the hair follicles. Dusting the arms with a powder containing equal parts of starch and zinc oxide before commencing work prevents action of the oil on the skin.

"(b) *Cleanness of the Lubricant.* — Care must be taken in the handling of the constituents before blending that they have not undergone changes (*e. g.*, formation of free fatty acid).

"Constant removal of metal particles is necessary to avoid injury to the skin. Filtration, such as is provided on the machines, and centrifugal action are insufficient to remove the minute metal particles which may injure the skin. Where cutting oils (straight oils) are used, their viscosity can be diminished by heat sufficiently to allow the particles to sink without affecting their value as lubricants. This operation completely removes all metal particles. In other lubricants where such a procedure is impossible it is necessary constantly to change and renew the cutting lubricants.

"(c) *Cleanness of the Machines.* — Frequent cleaning of the machines with the removal of all the old lubricant from all parts of the machine is essential.

"3. *Addition of Disinfectants or Antiseptics to the Lubricants.* — Various antiseptics, carbolic acid (1 per cent. to 2 per cent.) being the most common, have been added to the lubricant to prevent rashes, and in the case of cutting emulsions 0.5 per cent. of disinfectants soluble in water have been used for this purpose. The results obtained have not been altogether satisfactory, and reliance cannot be placed upon such a method to prevent skin rashes.

"4. *Sterilization by Heat.* — It has been suggested to heat the cutting oil to 300° F. for a short period with a view to sterilizing it as well as to increase its antiseptic or germicidal action.

"Laboratory experiments in America have shown that used oil possesses rather marked germicidal effects, and in view of the fact that the used oil becomes heated during use attempts were made to determine whether heating new oil would also bestow upon it germicidal powers. Apparently, heating does produce such a change, but the temperature required is upwards of 125° C. The actual temperature required to produce this germicidal action in the oil has not yet been determined, but it has been recommended to mix new oil with the used oil before filtering and heating, so that the new oil would possess to some extent the germicidal power of the used oil.

"5. *Removal of Workers with Septic Infection of the Hands.* — Workers whose hands become the seat of septic infection should not be allowed to work on machines, as they are liable to infect the oil with germs and so infect others.

"6. *Treatment.* — (a) *Folliculitis Produced by Blocking of the Glands.* — As a general rule, frequent washing with soap and hot water is sufficient to produce a rapid cure. The skin may be subsequently dusted with zinc oxide and starch powder.

"It has been found that where this is insufficient a mild antiseptic applied on lint has relieved the irritation and given good results.

"(b) *Septic Infection of the Skin due to Cuts.* — Septic infection should be treated on general principles by the application of suitable antiseptic dressings.

"7. *Susceptibility.* — Certain individuals appear to be particularly susceptible to the action of lubricants. Such persons when found should be removed from contact with oil." — K. R. Drinker.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Public Service Under Government Operation of the Railroads. *Max Thelen.* Ann. Am. Acad. Pol. Sci., Nov., 1919, 86, No. 175, 15–34. — Pages 29 and 30 contain a brief account of the work of the Safety Section of the Division of Operation. The Safety Section has provided for Safety Committees on all railroads, and has inaugurated a "No Accident Week" Campaign. No Accident Week (June 22–29, 1919) in the Northwestern region showed a decrease of 75.26 per cent. in the total number of accidents as compared with the corresponding week of the previous year. Most of this decrease was in non-fatal accidents. The writer credits a large part of the success of the Safety Committees to uniform control. — C. H. Paull.

Shipping Containers. *C. P. Beistle.* Jour. Soc. Chem. Indus., Sept. 15, 1919, 38, No. 17, 330–337. — An account of the work of the Bureau of Explosives in improving specifications for shipping containers for inflammable and explosive materials, etc. Statistics are given showing the consequent decrease in loss of life and property. — C. H. Fiske.

Explosions in Coal Mines. *J. S. Haldane.* Jour. Soc. Chem. Indust., Sept. 15, 1919, 38, No. 17, 338–339. — To prevent gas explosions in mines, it would be necessary to reduce the oxygen content to less than 14 per cent. The high per cent. of carbon dioxide that would result if this dilution were made with flue gas would seriously interfere with the workers. All serious coal-mine explosions depend upon propagation by ignited coal dust; consequently the best preventive device is to dilute the coal dust with inert material. This can be done by covering the mine roads with stone dust. — C. H. Fiske.

Note on Explosions in Coal Mines. *George Harker.* Jour. Soc. Chem. Indust., Sept. 15, 1919, 38, No. 17, 338. — The use of flue gas to prevent mine explosions (by diminishing the oxygen content

of the atmosphere) is not safe unless all carbon monoxide is removed. It is suggested that decreasing the oxygen content to 17 per cent. would probably affect the working capacity of the operators. As an alternative method, the author proposes that the mine be divided into various parts separated from one another by layers of inert gas. — C. H. Fiske.

INDUSTRIAL SURGERY

First French Congress on Orthopedic Surgery. *Albert Mouchet.* Presse méd., Oct. 29, 1919, 27, No. 63, 637. — A report of the proceedings of the meeting. Many eminent French surgeons discussed the three questions proposed: Amputations and their Relations to Prostheses, Spondylitis in War Surgery, and Treatment of Pseudarthroses. — T. J. Putnam.

The Technique of Intracardiac Injections. *Joh. Volkmann.* Deutsch. med. Wchnschr., Aug. 28, 1919, 45, No. 35, 968–969. — The author has used intracardiac puncture in twenty-six cases of cardiac failure from various causes. The fourth left interspace at the edge of the sternum is palpated and marked with tincture of iodine. A local anesthetic is seldom necessary. The operator stands at the patient's left, facing him, holding in his right hand a No. 4, 6-cm. needle, with a cork transfixed upon it 4 to 5 cm. from the point. The needle is introduced in the angle between the edge of the sternum and the fourth and fifth ribs, pointing a little upward and toward the midline in the plane of the fourth interspace. As it is pushed in, it encounters the hard surface of the heart muscle. The pericardium is seldom to be felt. The needle now begins to move up and down from the contractions of the heart. It is pushed on up to the cork, then cautiously 1 cm. further until blood flows from it, the right chamber lying from 4 to 5 cm. below the surface. Injections should not be made into the heart muscle itself. The mammaries, intercostals, and vagus are thus avoided, and a negligible amount of damage is done to the heart and overlying tissues.

It is doubtful whether merely pricking the heart acts as a stimulus, although the injection of simple salt solution so as to raise the intracardiac pressure may do so. The most effective procedure, however, is to inject 1 c. c. of 1–1000 epinephrin solution in 20 c. c. normal saline, in the course of about two minutes. The effect is usually noticeable in two or three minutes more, and the stimulation may then be reinforced by a dose of strophanthin, well diluted with saline to prevent the heart from "running dry." The author believes that the instruments for cardiac puncture, like those for tracheotomy, should be a part of the equipment of every clinic. — T. J. Putnam.

Treatment of Complicated Finger and Hand Wounds by Traction Splints. *Heinz Walther.* Deutsch. med. Wchnschr., Sept. 18, 1919, 45, No. 38, 1048–1050. — In severely traumatized hands, it is necessary to prevent the spread of infection, to fix injured joints in the most normal position possible, and to preserve or restore their function. Ordinary splinting is most effective in combating infection, but often produces lasting stiffness of the joints. As in larger joints, traction is the most efficient means of treatment to meet the other indications. The author describes a simple traction apparatus. Strong wire netting (Kramer-Schiene) is used as a splint, and dorsal and palmar pieces are cut about 10 cm. broad and long enough to extend from the elbow to 40 cm. beyond the tips of the fingers. These are moulded, padded, and bound in place, and the cross-wires are removed from their projecting ends. The bared longitudinal wires are then bent through a large arc or a circle, and their ends are brought into position to be used as points of traction. From them threads are extended under moderate tension to holes drilled through the nails of the injured fingers, where they are fastened. This obviates the use of adhesive plaster and of rubber bands, both of which are unobtainable in Germany.

Such an apparatus is light and not uncomfortable, and does not require the patient to be kept in bed. It minimizes the necessity for incisions, and permits the treatment of the wound by the "open" method, or by dressings. The author uses dry sugar as a dusting-powder, believing that it is slightly antiseptic and stimulates the flow of lymph. His results have been excellent. — T. J. Putnam.

FATIGUE

Fatigue and Industrial Efficiency. *Walter N. Polakov.* Ind. Management, Dec., 1919, 58, No. 6, 448–452. — The writer bases his conclusions upon his experience in observing the relation of hours of labor, monotony, etc., to fatigue in power plants. Fatigue in power plants is evident not so much in the worker's inability to perform manual work as in his inability to get satisfactory results. He may be able to put just as much coal on the fire, but he will not maintain his pressure uniformly. This is due, the writer points out, to occupational fatigue, being in a considerable measure of nervous origin. By charts it is shown how fatigue brings about certain tendencies in productive work, both within the day and within the week, and how important the element of fatigue accumulation is. The end of the week shows a fatigue accumulation which, if not relieved by a day of rest, will be carried along even over a term of years.

In conclusion, the writer says: "The task of engineers viewed in this light is this, to provide opportunities for leisure rather than to invent new yokes and tread mills." — C. H. Paull.

WOMEN AND CHILDREN IN INDUSTRY

Women in the Lead Industries. *Alice Hamilton.* U. S. Bur. Labor Statis., Bull. No. 253, Feb., 1919. — This is a thirty-eight page pamphlet dealing with the subject of women in the lead industries. The material is dealt with under the following subject headings: What is Industrial Lead Poisoning or Plumbism, Individual Susceptibility, Lead Poisoning in Women, Lead Compounds Used in Industry and their Comparative Danger, How Does Lead Enter the Body, Lead Industries in the United States (lead mining, lead smelting and refining, metallic-lead industries, manufacture of white lead, grinding of paint, painting trade, commercial artists or retouchers, lithotransfer work, manufacture of red lead and litharge, manufacture of storage batteries, glazing of pottery and tiles, manufacture of porcelain enameled sanitary ware, compounding of rubber), and Prevention of Lead Poisoning. — K. R. Drinker.

Output of Women Workers in Relation to Hours of Work in Shell Making. U. S. Bur. Labor Statis., Month. Labor Rev., Oct., 1919, 9, No. 4, 217–219. — This is a brief comment on Report No. 2 of the Industrial Fatigue Research Board (British) entitled "The Output of Women Workers in Relation to Hours of Work in Shell Making." A study of the comparative hourly output under shifts of different lengths showed that the work (under the control of the women as far as speed was concerned) accomplished in 100 minutes of the long-hour system (12-hour shift) was carried out in 80.5 minutes of the short-hour system (7 to 8-hour shift), a decrease of 19.5 per cent. in time. A study of hourly output led to the following general conclusions:

"The curves of output for the short shifts give evidence of the possibility of running at full output right to the end of the shift, but the curves for the long shifts give no such evidence.

"A comparison of the same workers' output records for the long and short shifts shows inferiority in hourly output during the later hours of the long shifts.

"No evidence of detrimental effect of night work in comparison with day work is traceable." — K. R. Drinker.

Women in the Railroad World. *Pauline Goldmark.* Ann. Am. Acad. Pol. Sc., Nov., 1919, 86, No. 175, 214–221. — The writer calls attention to the common misconception regarding the character of the work done by women in connection with the railroads during and since the war. About 70 per cent. went into clerical work. Many of these were relatives of men who had entered the army. Relatively few women did rougher manual work. In railroad shops at the time of maximum employment only 5 per cent. of the total employees were women. About the same proportion of women were employed in the signal service. Only 1 per cent. of the workers in roundhouses and on the tracks were women.

In general, it has been found that the heavier manual labor is unsatisfactory for women. Since the end of the war there has been a marked falling off in the number of women employed. This is ascribed to several causes. Many men returning from war were reinstated and women were naturally laid off, since they had in most cases been most recently employed. There was also a reduction in the railroad force during 1919 which affected women. Then there was a falling off of women employed in rougher labor, due to their not being physically fit for the work. — C. H. Paull.

The Relation of Alcohol and Alcoholism to Maternity and Child Welfare. *Mary Scharlier.* The Child, Dec., 1919, 10, No. 3, 97–107. — A brief summary is made of recent work and opinion on the subject of germ pathology and the relations of alcohol to the unborn child. All these experiments and observations go to prove the fallacy of the old belief that expectant and nursing mothers should drink stout. In addition to the difficulties to which all women are subject as a consequence of child-bearing, the industrial women have their special temptations — temptations which ought not to exist and which should be abolished by the pressure of instructed public opinion. Exhaustion from overwork, too long shifts of work, excessive distance to and from work, inadequate conditions of transportation, have all been shown to be factors endangering the sobriety of women workers. All the available data "point clearly to the conclusion that amongst the women of this country (England) there has been considerable progress towards a higher standard of sobriety." The conditions during the war have been good, and there has been little complaint of the conduct of women. Occupation, steady wages, and independent, self-supporting careers have developed the best qualities of women, and have been in all respects, but particularly with regard to health, beneficial to the community. — G. E. Partridge.

Some Problems of the Work Age Level. *G. G. Ide.* The Psychological Clinic, Dec., 1919, 13, Nos. 1–3, 75–87. — The law of Pennsylvania requires school attendance of all children from the ages of 8 to 16 years, except that the child who has reached the age of 14 and has completed the sixth grade may satisfy the requirements by attending continuation school for one day each week. There are several evils of this system. The children who leave school before the age of 16 are usually those who need training of a kind which the schools do not give, but which, under pressure, they should be made to offer. In the second place, it is an unnecessary waste for the schools to be burdened with children who are discovered, too late, to be failures in their studies. At present, unless a child remains in one grade several

years, little effort is made to discover the cause of retardation. There should be earlier differentiation of the group and of the curriculum. There should be more work definitely directed toward fitting the child for remunerative labor, so that the deficient child and all who do not progress well in school may have a better chance than they do now. — G. E. Partridge.

Filling in the Gaps of Child Life. *John C. Gebhart.* Survey, Dec. 27, 1919, 43, No. 9, 313–314. — The writer calls attention particularly in this article to the necessity for developing greater facilities for the care of children between the ages of 2 years and 6 years. In this period of four years, the child has passed beyond the care of the baby clinic and has not reached the age where attendance at school brings him under the care of the school physician. During this period of lack of attention, the foundation is often laid for future weakness and ill health. The New York Association for Improving the Conditions of the Poor undertook an education campaign in certain selected areas to bring children between the ages of 2 and 6 years under proper medical observation. This work was done largely by reaching the mothers through visits. The importance of proper nourishment was particularly emphasized. Most encouraging results have been obtained. — C. H. Paull.

INDUSTRIAL SANITATION: ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

The Rôle of Ventilation in Preventive Medicine. *George T. Palmer.* Mod. Med., Oct., 1919, 1, No. 6, 509–515. — Statistics on respiratory diseases are quoted, showing a higher death rate in winter months. Reference is also made to experiments under different temperatures. The article ends with suggestions for a cool air campaign under the direction of public health officers. — A. B. Emmons.

Water Supply and Sanitary Engineering, 1919. Engineer, Jan. 2, 1920, 129, No. 3340, 10–112. — A review of the general progress of sanitary engineering with especial reference to its influence upon design and construction of works begun or completed during 1919. — G. M. Fair.

Field Methods for the Chlorination of Small Amounts of Water. *F. R. Georgia.* Jour. Am. Waterworks Assn., Nov., 1919, 6, No. 4, 654–664. — A description of some of the methods used in the American Expeditionary Forces to chlorinate small amounts of water by the use of home-made devices. Tables of some of the bacteriological results obtained are also included. — G. M. Fair.

Prevention and Cure of "Red Water." *William H. Walker.* Munic. Jour., Nov. 22, 1919, 47, No. 21, 312–314. — The cure of "red water" lies in the prevention of the rusting of iron pipes, especially in hot-water systems, by removing the oxygen from the water in a deactivator in which the oxygen is consumed by corroding iron sheets chemically treated so that rapid corrosion of their surface takes place. The iron rust taken into suspension is subsequently removed by filtration. — G. M. Fair.

The Relative Sanitary Values of Different Types of Drinking Fountains. Part II. How the Fountains are Used, and the Results of Tests of Sloping Stream Types. *Louis V. Dieter.* Am. City, Dec., 1919, 21, No. 6, 549–554. — In observations of the methods used by some 1,500 to 2,000 drinkers from practically all types of fountains, Mr. Dieter found that despite guards a surprisingly large number of drinkers managed to place their lips upon the nozzle, that at least 40 per cent. placed their mouths directly on the guard, and that others had the pernicious habit of placing their hands and fingers on the nozzle. Laboratory tests and examinations of public fountains of the sloping stream type showed that it is possible to design fountains of this type so that they are safe. At the same time, however, it was found that many fountains of this type, which are in use today, are no better than the vertical stream fountain. The author's conclusion is that a fountain is strictly sanitary when it complies with the following rules:

1. It must not depend upon the personal element.
2. It must be impossible for organisms or other foreign particles to dance on the bubble.
3. It must be impossible for washings from the mouth to fall back upon or splash on the nozzle.
4. It must be impossible to touch the nozzle with the mouth or with the fingers.
5. It must be impossible for the mouth of the drinker to come in contact with the guard during the process of drinking. — G. M. Fair.

Report of Committee on Private Fire Protection Service. Jour. Am. Waterworks Assn., Nov., 1919, 6, No. 4, 679–784. — This extensive report takes up in detail the physical and fiscal questions of private fire protection services. The physical questions bearing more directly upon industrial hygiene are summed up as follows:

"1. Water for domestic or commercial uses should be furnished through the same pipe with water for private fire protection equipment for certain classes of consumers only, in which case the service should be properly metered. In no case should a combined connection be allowed for factories, large industrial establishments, or railroad terminals and yards.

"2. No fire service connection should be installed without a fire service meter unless a system similar or equivalent to the 'Bond-Alarm-Inspection System' is adopted.

"3. No private fire service connection should be installed without careful and adequate provision for properly located control valves equipped with indicator posts.

"4. No service connection with a capacity in excess of 50 per cent. of the water main supplying it should be installed. All risks requiring more than 50 per cent. of the main should be required to provide a supplemental water supply by storing water in elevated tanks.

"5. Where an independent supply is used for private fire protection, the fire service connection from the public mains should discharge either into a cistern or elevated tank at or above the flow line and the protected property required to take water for fire protection equipment from the cistern or tank to preclude the possibility of back flow. When such an arrangement is not possible of attainment, double check valves should be installed with proper means for inspection and testing. Such valves should be regularly and systematically inspected and reports filed as to their condition."

Valuable references to the legal, economic, structural, and hygienic sides of the problem are appended to the report. — G. M. Fair.

Are Check Valves Between Public and Private Water Supplies Necessary or Safe? *Caleb M. Saville.* Am. City, Dec., 1919, 21, No. 6, 558–561. — The writer believes that the matter of interconnecting public and private water supplies resolves itself into a question of expediency for local determination — that is, which is the lesser of two evils, danger to public health or risk of conflagration with its attendant hazard to human life and continuity of employment, not to mention loss of property? If connection is decided to be necessary, without doubt the double check value in its latest design and rigid inspection will afford the best protection at present available. The haphazard interconnection of private and public supplies, of which an instance leading to the contamination of the Hartford supply is cited, is naturally to be condemned. — G. M. Fair.

An Important Feature in Plumbing Specifications. *J. J. Cosgrove.* Am. Arch., Dec. 3, 1919, 116, No. 2293, 705–706. — The Sanitary Potters' Association by a recent resolution has declared that after April 1, 1920 they will make no more closets with projecting outlet horns. This makes it impossible to set the new type closet in putty — a method formerly specified — and will lead to the adoption of the better metal-to-metal flanges in fastening closets to the floor. The following wording from the Industrial Code of the state of New York is recommended as a standard form of specification: "Rule 120. The connection between soil pipe and water closet hereafter installed shall be made by means of a flexible, metal-to-metal closet floor flange. Putty, paste, gasket, slip joint or rigid connections of any kind will not be permitted for water closets or slop sinks." — G. M. Fair.

Disinfection of Sewage. *Chester G. Wigley.* Munic. Jour., Nov. 15, 1919, 47, No. 20, 292–293. — A discussion of results obtained at Millville and Camp Merritt by the use of chlorine gas for the disinfection of sewage. The results of a series of tests are given. — G. M. Fair.

Lawrence Sewage Treatment Studies. Munic. Jour., Dec. 27, 1919, 47, No. 26, 345–346. Excerpts from the latest Annual Report of the Massachusetts State Department of Health are given. — G. M. Fair.

Milwaukee Sewage-Testing Station: Experimental Data. Engin. N.-Rec., Dec. 25, 1919, 83, No. 22, 1063. — Results of sewage experiments with fine screens, activation tanks and Dorr thickeners at the testing station of the Sewerage Commission of Milwaukee are recorded in the annual report for 1918 from which this article is abstracted. The rate of activated sludge treatment was doubled by pre-screening. The Dorr thickeners reduced the sludge moisture to 98.5 per cent. — G. M. Fair.

Capacities of Small Septic Tanks. *F. E. Peters.* Munic. Jour., Nov. 22, 1919, 47, No. 21, 309–310. A discussion of the requirements of various authorities relating to the capacity of septic tanks is followed by a résumé of the standards adopted by the State Board of Health of North Carolina for septic tanks used by schools, homes, and industrial plants. The standards relating to industrial plants are as follows:

Septic tanks for mills and similar industrial plants equipped with baths must have 25 gallons capacity per person up to twenty operatives, and 20 gallons per person above that number. Where baths are not provided, 20 gallons per person are required up to twenty employees, and 15 gallons per person after that. The minimum capacity of the tank under this ruling is 400 gallons. Seven and a half square feet of sand area are required per person for intermittent filtration of the effluent from the tank. — G. M. Fair.

Economic Values in Sewage-Sludge. Munic. Jour., Nov. 8, 1919, 47, No. 19, 278–279. — This is a review of Mr. Raymond Wells' paper read before the American Society for Municipal Improvements on November 12. The paper is printed in full in the Canadian Engineer, Dec. 25, 1919, 37, No. 26. — G. M. Fair.

Economic Values in Sewage and Sewage Sludge. *Raymond Wells.* Canad. Engin., Dec. 25, 1919, 37, No. 26, 563–566. — After a brief description of the methods applicable to utilizing the economic values in sewage sludge, the adaptation of the Cobwell process for the recovery of grease and the preparation of fertilizer is considered. Beginning with a sludge containing 3 to 3.3 per cent. ammonia and 10 to 15 per cent. grease on the dry basis and an initial moisture of 75 to 80 per cent., it is possible by this method to produce marketable grease and fertilizer sufficient in quality and quantity to defray the cost of operation. — G. M. Fair.

Treatment of Canning Plant Wastes in Wisconsin. *E. J. Tully.* Engin. N.-Rec., Dec. 11–18, 1919, 83, No. 21, 1017–1018. — The State Board of Health of Wisconsin has prepared general plans for treating the industrial wastes from canning plants. These wastes consist of washings, silage juice and cooling water. Different methods of treatment are recommended, depending upon the type of waste dealt with. The cooling water requires no treatment and should be separated from the other wastes. For the washings, screening, settling and straining through crushed stone are recommended. Silage juice, which is acid in reaction, is best treated with lime or soda ash, settled and passed through coke and gravel filters. It is also possible to treat both types of waste in a combined plant. — G. M. Fair.

Studies on the Treatment and Disposal of Industrial Wastes. 3. Purification of Tannery Wastes. *Harry B. Hommon.* U. S. Pub. Health Ser., Pub. Health Bull. No. 100, Nov., 1919. — A pamphlet of 133 pages dealing with the purification of tannery wastes. — K. R. Drinker.

INDUSTRIAL NURSING

The Visiting Nurse Association. Mod. Med., Oct., 1919, 1, No. 6, 507–508. — This suggestive editorial points out the development of visiting nurse associations and their success in solving the three fundamental problems of public health work, namely, clinical specialization, graded financial service so that the poor as well as the well-to-do may seek advice early, and intimate blending of prophylaxis and therapeusis. The medical profession still faces the satisfactory solution of these three problems in regard to itself. — A. B. Emmons.

Industrial Nursing. *Yssabella Waters.* Pub. Health Nurse, Sept., 1919, 11, No. 9, 728–731. — A brief review of the growth of industrial nursing in the United States since the appointment of a nurse by the Vermont Marble Company in 1895, and the rapid diverse development of industrial nursing service in factory, mine, logging camp and store. Miss Waters reports that at present 871 industries in the United States are employing 1213 graduate nurses. — Ida Cannon.

The Industrial Nurse and the National Organization for Public Health Nursing. Pub. Health Nurse, Dec., 1919, 11, No. 12, 987–989. — An interesting statement of the opportunities of the industrial nurse and the urgent necessity for more carefully trained women. Specialized training is needed. Many industrial nurses have not had this opportunity, but special lecture courses are available to many, literature on the subject is increasing, and, through the Committee on Industrial Nursing of the National Organization of Public Health Nursing, industrial nurses can promote their own development. "The local and state organizations offer frequent opportunities for mutual improvement, and with the help of the National Organization can eventually develop standards for industrial nursing, the observation of which will make industrial nursing by specially trained public health nurses a kind of service desired by every employer and employee." Ida Cannon.

Notes on General Activities. The Committee on Industrial Nursing of the National Organization for Public Health Nursing. Pub. Health Nurse, Nov., 1919, 11, No. 11, 902–903. Miss Florence S. Wright, the chairman of the committee, outlines a plan for securing the opinion of the industrial nurses of the country concerning the advisability of forming a special section for industrial nurses as part of the National Organization for Public Health Nursing. The next annual meeting is to be held at Atlanta, Georgia, April 12 to 17, 1920. — Ida Cannon.

Responsibilities and Opportunities of the Industrial Nurse. *Florence Swift Wright.* Pub. Health Nurse, Nov., 1919, 11, No. 11, 854–859. — A most suggestive and practical presentation of the opportunities of the industrial nurse who, through her contact with the foreign born in mine, mill, factory, store and home visiting, can interpret American standards and further health education. Miss Wright sees these opportunities as definite responsibilities. — Ida Cannon.

Pamphlets on Public Health Nursing. Pub. Health Nurse, Sept., 1919, 11, No. 9, 749–758. — The Library Department of the National Organization for Public Health Nursing calls attention to the packages of pamphlets on any phase of public health nursing, which may be borrowed on application to the librarian of the department at the New York office, 157 Fifth Avenue. Industrial nurses should take advantage of this opportunity. — Ida Cannon.

Notes From the Field. Pub. Health Nurse, Nov., 1919, 11, No. 11, 904–906. A brief report is given of the discussion at the annual meeting of the National Safety Council in Cleveland in October, 1919, of the trained nurse in industry. — Ida Cannon.

The Future of Public Health Nursing in California. *Edna L. Hedenberg.* Pub. Health Nurse, Oct., 1919, 11, No. 10, 787–793. In this article Miss Hedenberg pays tribute to the value of the nurse in industry and anticipates for her an increasing opportunity for furthering a better understanding between employers and employees. — Ida Cannon.

Study of the Public Health Nursing in Westchester County. *Zoe La Forge.* Pub. Health Nurse, Aug., 1919, 11, No. 8, 635–657. — This is a brief reference to industrial nursing as one of the

types of public health nursing found in the survey. The chief interest of the article to industrial nurses lies in the recommendations for better co-ordination of all public health interests, of which the health of the industrial worker is an important part. — Ida Cannon.

NURSING WORK IN THE TELEPHONE COMPANIES. *Josephine Toering.* Pub. Health Nurse, Oct., 1919, 11, No. 10, 793–795. — In this article the author gives a brief statement of the organization of the medical service of the New York Telephone Company, the Bell Telephone Company of Pennsylvania, and the Chesapeake and Potomac Telephone Company, which comprise the Eastern Group of Telephone Companies. The nursing for all these companies is under the supervision of one nurse who has charge of the twenty-one nurses distributed throughout the three telephone companies. — Ida Cannon.

A HEART-TALK WITH INDUSTRIAL NURSES. *Mary A. Meyers.* Pub. Health Nurse, Dec., 1919, 11, No. 12, 981–986. — A very frank and critical statement of the present standards of industrial nursing. Miss Meyers challenges the nurses who fail to live up to the best that the public health nurse should have to offer to industry, and makes clear the necessity for those who see the opportunities in industrial nursing to work together to formulate standards of service. — Ida Cannon.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

THE TOWN PLAN AND THE FACTORY. *Louis B. Duff.* Canad. Engin., Dec. 18, 1919, 37, No. 25, 544–545. — A short discussion of the importance of logical planning for residential and industrial growth, and its bearing upon industrial progress and social gain. — G. M Fair.

STATE AID FOR WORKMEN'S DWELLINGS IN ITALY. U. S. Bur. Labor Statis., Month. Labor Rev., Oct., 1919, 9, No. 4, 282–283. — A brief review of a decree issued in Italy in March, 1919, providing for extensive state aid for the construction of workmen's dwellings. — K. R. Drinker.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

HEALTH HAZARDS OF THE CHEMICAL INDUSTRY. N. Y. State Dept. Labor, Special Bulletin No. 96. Nov., 1919, pp. 69. — "The chemical industry in the State of New York has grown to such a degree and seemed to present so many dangers, both to the employer and employee, that an investigation was undertaken, by the Bureau of Inspection of the State Industrial Commission, to study those hazards which accompany the industry.

"Partly covering the industry, three hundred and thirty-five plants were visited and particular attention given to those conditions to which the present laws and rules do not apply, the following conditions being carefully studied, *viz.*: (1) The heating of factories with the fire hazards presented thereby; (2) Lighting of factories, and the location of switches, fuse plugs, and electric bells particularly where inflammable liquids were used and the danger of explosion was present; (3) Tanks, particularly those in which there was the possibility of the generation of excessive pressure; (4) Hazards due to breaking up of raw materials; (5) Spontaneous combustion occurring in certain materials; (6) Industrial poisonings not reported to the Industrial Commission because they are not included in the list enumerated in Section 65 of the Labor Law; (7) Causes of explosions which occurred during the course of the investigation; (8) Lack of knowledge, by the men employed, of the character of the materials handled as shown by the careless modes of handling both raw material and finished products; and (9) General safe and unsafe practices."

The conclusion reached by the investigators, as a result of this survey, is that the general conditions found show the necessity for the drafting of a number of rules by the New York State Industrial Commission, which shall be placed into effect as law to remedy the various conditions which are dangerous to employee and employer alike. Recommendations for these rules are appended. — L. A. Shaw.

WAGES AND HOURS OF LABOR IN THE IRON AND STEEL INDUSTRY, 1913, 1914, 1915, 1917, 1919. U. S. Bur. Labor Statis., Month. Labor Rev., Oct., 1919, 9, No. 4, 104–126. — An article containing statistics concerning hours and earnings of employees in the iron and steel industry during the years enumerated in the title. — K. R. Drinker.

WAGES AND HOURS OF LABOR IN THE BOOT AND SHOE INDUSTRY: 1907 TO 1918. U. S. Bur. Labor Statis., Bull. No. 260, Nov., 1919, pp. 135. — This report presents the rates of wages (or earnings) per hour, hours of labor per week, and full-time and actual weekly earnings in the year 1918 in the boot and shoe industry of the United States. Comparable figures for 1916 and summaries for each year from 1907 to 1918, except 1915 and 1917, are also shown. — K. R. Drinker.

WAGES AND HOURS OF LABOR IN THE COAL MINING INDUSTRY IN 1919. U. S. Dept. Labor, Bur. Labor Statis., pp. 20. — This article presents in a summary form the facts as to hours of labor and earnings of employees in the coal mining industry in 1919. No attempt was made to secure data from all mines or from all mining states. In the anthracite fields the survey was confined to twenty-two mines operated by ten different companies all located in Pennsylvania. Approximately one-tenth of all em-

ployees in the anthracite coal region are employed in these mines. Care was taken that the mines included in the survey were selected so that the results would be fairly typical of the entire anthracite field. In the bituminous territory the survey covered 201 mines situated in eighteen of the most important mining states. It included a total of 40,508 employees

The article includes information concerning the hours and earnings of both inside and outside laborers in both anthracite and bituminous mines. For each occupation, i. e., inside or outside labor, data are given concerning the average hours actually worked during the payroll period, the average hours per week-day worked by employees in that occupation, full-time hours for the payroll period; the average amount actually earned during the payroll period, the average earnings per hour actually worked and the full-time earnings for the period. — K. R. Drinker.

Wages and Hours of Labor in the Slaughtering and Meat-Packing Industry, 1917. U. S. Dept. Labor, Aug., 1919, Bull. No. 252. — A report of 1114 pages dealing primarily with rates of wages, hours worked and earnings of employees by occupations for one payroll period in 1917, and describing the work of the employees in the various occupations. — L. A. Shaw.

Wages of Candy Makers in Philadelphia in 1919. U. S. Dept. Labor, The Woman in Industry Service, Bull. No. 4, June 28, 1919, pp. 46. — This report resulted from a request of the Women's Trade-Union League of Philadelphia that the Woman in Industry Service (United States Department of Labor) investigate wages in the candy factories of Philadelphia, on the ground that the earnings were reputed to be less than the cost of living. A complete survey of wages paid, condition of workrooms, hours of employment, processes in the industry, etc., was thus made. Suggestions follow as to remedies which should be instituted. — L. A. Shaw.

The Division of Industrial Hygiene offers Special Services to Employers. Week. Bull., N. Y. City Dept. Health, Dec. 6, 1919, 8, No. 48, 385. — The Department of Health announces that its Division of Industrial Hygiene is prepared to make a sanitary survey of factories, office buildings, etc., upon application from those interested. — L. A. Shaw.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

A Statistical Study of Intelligence as a Factor in Vocational Progress. *K. M. Cowdery.* The Journal of Delinquency, Nov., 1919, 4, No. 6, 221–240. — This paper presents a study of the relations of measurable general intelligence to the ability to make progress under vocational instruction in various occupations. The subjects are delinquent boys, most of them from 14 to 18 years of age. The intelligence ratings are made by the Stanford tests. The vocational-progress ratings are based upon monthly reports made by the trade instructors and recorded, after being analyzed, upon a five-point scale. So far as possible, increased proficiency and skill rather than attitude, spirit, or the like, are used as the measurable quality.

The result is that little definite correlation is shown in the totals. For 516 ratings (twenty-four occupations grouped together) there is a positive correlation of 0.143 between intelligence quotient and vocational progress. But when the correlations are computed for different trade groups, different results are obtained. Taking the expert trades — the mechanical and the garment trades — the coefficient of correlation becomes 0.304. A coefficient of 0.705, found in the ratings for bindery work, appears to be the highest correlation found. In the culinary trades the correlation is −0.022, and for the agricultural details, −0.042, which appears to be the lowest point reached. Although part of the results are based upon comparatively small numbers of cases, the author thinks that some general conclusions are allowable. Distinct correlations must be admitted and in some cases *critical levels* are clearly defined, but it cannot be said that intelligence level is anywhere a trade test, in the sense of indicating those who will succeed to the exclusion of all others. The conclusion is offered that degree of mental ability can be a definite, measurable, negative guide in vocation, and that boys of certain levels of intelligence can properly be directed away from certain trades. The main need, finally, is for trade tests which will mark out the positive factors that assure success in specific directions. — G. E. Partridge.

The Army Intelligence Tests at Purdue University. *G. L. Roberts* and *G. C. Brandenburg.* School and Society, Dec. 27, 1919, 10, No. 261, 776–778. — Eleven hundred and fifty-nine students at Purdue University were examined — about 85 per cent. of the total student enrollment — and practically every student was sufficiently interested to come later for his score. Chemical engineers made the highest average; the average score for women students was eleven points lower than the score for men. As compared with the records of an unselected group — so far as the group of men subjected to the tests in the army can be called unselected — the students tested show a far higher level of general intelligence. — G. E. Partridge.

Point Scale Examinations on the High-Grade Feebleminded and the Insane. *Josephine N. Curtis.* Bulletin of the Massachusetts Commission on Mental Diseases, Jan., 1919, 3, No. 1, 79–105. — It was desired to "determine as accurately as possible the intellectual level reached by individuals

who had proven that they were just unable to get along by themselves in the world, and to ascertain for these cases the range of variation in intellectual ability." The child scale was unsuitable, since with it the highest grade subjects attained scores equal to those of normal subjects, and it was plain that not enough difficult tests were included in the scale to give chances for the subnormals to display their inferiority. Thereupon the preliminary form of the Yerkes-Rossy adult point scale was given to about thirty subjects, followed by a test made upon 200 additional cases. The results of the study concern exclusively the reliability of methods and scales, and the relations of methods to one another. — G. E. Partridge.

The Meaning of a Binet Score. *H. J. Humpstone.* The Psychological Clinic, Dec. 15, 1919, 13, Nos. 1–3, 18–26. — The author's criticism of the Binet tests is directed not so much against the work of Binet as against the use to which the tests have been put by American psychologists. Several fallacies are prevalent. Among them is the assumption that the mental age of the normal child can be used as a measure of the mental condition of the feebleminded, which is not true, since there is a qualitative difference between the normal and the abnormal. The principal objection to the current use of the Binet methods is that they do not show definite competencies, and so are particularly ineffective when vocational guidance is in question. We need to be clearer about the precise function of mental measurement. The Binet score really records only a performance level on the intellectual scale. This is one element useful in giving a diagnosis of the child's mental ability, which may, however, be obtained without the use of a Binet test and in many cases in much less time than it takes to give the Binet test properly. However it is obtained, it is only one fact and no diagnosis is valid that is made upon it alone. — G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

Recreation in Industrial Communities. *A. H. Wyman.* American Physical Education Review, Dec., 1919, 24, No. 9, 473–480. — This is mainly a record of the activities of the Carnegie Steel Company in Pittsburgh, with a summary in the form of a table showing the facilities and the recreational activities in fourteen mill districts during four months of the outdoor season in 1919. Recreation in industrial communities has been more or less successful, the writer maintains, according to the social agencies that have fostered the movement. With the direct backing of the industrial managers much good has been done. There has been a noticeable change in the physical alertness of employees; through inter-departmental and inter-plant competition there has grown up a better spirit, a truer sportsmanship; the relations among heterogeneous groups of men have become closer; and there is more friendly feeling between workers and foremen and superintendents. — G. E. Partridge.

Community Recreation from the Point of View of Physical Education. *Florence D. Alden.* American Physical Education Review, Dec., 1919, 24, No. 9, 481–486. — "Ordinarily organizations for the furthering of recreation are supported in one of the following ways: entirely by the municipality, entirely by the community, partly by the community and partly by the municipality, or by the persons participating in the recreation features. The Public Athletic League of Baltimore is financed by a combination of almost all of these methods. . . . This varied support, together with the fact that the League owns no property but has its centers in public schools, parks, churches, old market halls, or any available spot, gives each center a personality all its own and makes it impossible to have any set pattern for its making and running." The paper contains practical advice for workers in this field. — G. E. Partridge.

Health Service Through Employees' Mutual Benefit Association. *Bert Hall.* Mod. Med., Oct., 1919, 1, No. 6, 499–505. — This article describes the activities and the benefits of a large Wisconsin employees' mutual benefit association. By prompt and early medical service, loss of time from illness has been reduced from 8+ days per man annually. A saving of 35.1 per cent. in the time lost was accomplished in one year, as shown by the chart. The financial savings thus made have been used for sick benefits, pensions, medical and nursing care of families. A women's auxiliary provided entertainments and neighborhood visiting. Mutual confidence and goodwill have been strongly cemented by this association. — A. B. Emmons.

INDUSTRIAL HEALTH LEGISLATION AND COURT DECISIONS: MALINGERING

Labor Legislation of 1919. Am. Labor Legis. Rev., Dec., 1919, 9, No. 4, 403–528. — A review of labor legislation, both federal and state. The *Analysis by Subjects and by States* shows a marked advance in health and safety legislation in many parts of the country. In private employment several states enacted or amended laws relating to hours of labor and types of work for women, Utah adopting an eight-hour day and North Dakota and Massachusetts establishing a forty-eight-hour week. In

several states legislation provided for continuation or part-time schools for employed children under a fixed age.

Among the most important legislation of the year was that by which Congress, through its taxing power, established a minimum age of 14 years for the employment of children in factories, and of 16 years for their employment in mines and quarries. In several states there was a marked reaction against women remaining in undesirable occupations which, in some instances, they had entered as a war emergency. In Ohio women are prohibited from working as watchmen, section hands, jitney drivers, gas or electric meter readers, etc.

North Dakota enacted a compulsory compensation act, while three other states, Alabama, Missouri and Tennessee, enacted elective compensation acts. More than thirty states amended their compensation acts—in most cases so as to increase indemnities, extend their scope, or furnish more satisfactory medical service. In three states legislation gave blind workers the right to waive claims for compensation.

The question of vocational rehabilitation was given attention in a number of states. California provided for a fund which is to be administered by the Industrial Accident Commission to provide for the re-training of workers disabled in industry. A number of other states have taken a step in the same direction as California. — C. H. Paull.

A New Social Law. *Georges Vitoux.* Presse méd., Nov. 22, 1919, 27, No. 70, 1002. — The French senate has recently adopted without discussion an amendment to the law of 1898 fixing the responsibility for occupational accidents upon the employer, extending its scope to include the diseases of occupation also. "The occupational risk being that inherent in a given profession, irrespective of the negligence of employer or employee, this risk should be taken by the employer, and should figure as a part of the general expenses of operation." But the difficulty arises in judging just which are truly occupational diseases. The present legislation recognizes only plumbism and saturnism, but allows for the possibility of a future extension of the scope of the law. — T. J. Putnam.

Rules and Regulations Pertaining to the Painting Business. Mass. State Board of Labor and Indust., Indust. Bull. No. 13, 1919. — This pamphlet deals with rules and regulations pertaining to the painting business in Massachusetts. It contains also numerous suggestions for the safety of employees in the painting business and a section on suggestions for health of painters from the point of view of instituting habits of cleanliness, suitable diet, regular bowel movements, avoidance of dust, etc. — K. R. Drinker.

Requirements for the Care of Employees Injured or Taken Ill in Industrial Establishments. Mass. State Board of Labor and Indust., Indust. Bull. No. 14, 1919. — This is a brief pamphlet dealing with the minimum requirements for the treatment of persons injured or taken ill in industrial establishments in Massachusetts. In every establishment employing 100 or more persons at least one first-aid or emergency room suitably located and properly heated must be provided, where those injured or taken ill upon the premises may receive first-aid treatment or rest. Requirements are enumerated for size of such rooms, character of floor and wall, provision for ventilation, location as regards quiet and privacy, presence of a nurse or other person competent to render first aid, first-aid equipment, and means for heating food. — K. R. Drinker.

Loss of Eye Greater Than Loss of Sight. Jour. Am. Med. Assn., June 28, 1919, 72, No. 26, 1935. (Nelson *v.* Kentucky River Stone & Sand Co. (Ky.), 206 S. W. R. 473.) — The following is quoted from the above issue of the Journal of the American Medical Association:

"The Court of Appeals of Kentucky reverses a judgment that affirmed an award of the workmen's compensation board for the loss of an eyeball the same as for the loss of the sight of an eye. The court says that it must consider the case in the light of the board's finding that the man's eyeball was removed and he was compelled to wear a glass eye, but that neither of these things impaired his earning capacity beyond the loss of the sight of his eye, or caused a disfigurement that impaired his future usefulness, or occupational opportunities. The question therefore was whether the award conformed to the Workmen's Compensation Act, and this depended on whether the injury fell within the specific schedule providing compensation for the loss of the sight of an eye, or under the general provision applying to all other cases. In this connection, it must be borne in mind that disfigurement impairing the future usefulness or occupational opportunities of the injured employee is not an indispensable condition to compensation under the general provision, since that provision applies 'in all cases of permanent partial disability, including any disfigurement,' etc. Hence the adverse finding of the board on this phase of the question was not controlling. Looking at the Kentucky act, we find that it provides compensation at a certain rate for 'the loss of a thumb,' the 'loss of a first finger,' the 'loss of a hand,' the 'loss of an arm,' etc., thus showing that the compensation therein provided for was confined to the loss of the particular member named. When it deals with the eye, however, it does not provide for compensation for the loss of the eye itself, but solely for the 'loss of the sight of an eye.' If it be true, and there is no reason to doubt the soundness of the rule, that the purpose of the legislature was to confine the fixed compensation provided for specific injuries to those injuries and no others, and that the compensation allowed for a specific injury was not payable for a less injury, the rule should work both ways, and the compensation provided for a particular injury should not be held to include a greater injury. Here, the employee lost, not only the sight of his eye, but the eye itself.

His injury therefore was greater than the mere loss of the sight of the eye. That being true, his case did not fall within the schedule making compensation solely for the loss of the sight of an eye, but fell within the general provision awarding compensation 'in all other cases of permanent partial disability,' etc."

Loss of One Member Before Employment and One After. Jour. Am. Med. Assn., July 5, 1919, 73, No. 1, 59. (Wabash Railway Company *v.* Industrial Commission et al. (Ill.), 121 N. E. R. 569.) — The following is quoted from the above issue of the Journal of the American Medical Association:

"The Supreme Court of Illinois affirms a judgement for compensation under the workmen's compensation act for a total and permanent disability in a case in which a man whose left arm had been amputated near the shoulder was employed by the railway company as a night watchman and while so employed fell over a pile of scrap iron and injured his left knee, as a result of which injury tuberculosis of the bone set in and his left leg was amputated about 6 inches below the hip joint. The company contended that the loss of one leg does not constitute total permanent disability; but the man contended that the loss of his left leg, combined with the previous loss of his left arm, constituted permanent disability. The court says that this precise question has not arisen before in Illinois. It has arisen in some other jurisdictions under compensation acts similar to that of Illinois. In Massachusetts and New York it has been held that under such circumstances the disability occasioned is total and permanent. This court is disposed to follow the reasoning of the Massachusetts court construing a statute quite similar to that of Illinois, and to hold that the latter applies when the loss of one of the members mentioned occurred previous to the employment, and the loss of the other occurred as the result of an injury arising out and in the course of the employment. This, in this court's opinion, is the fair intent and meaning of the act. When this man was employed by the railway company, he had lost his left arm, and his capacity for work was to that extent impaired. He was employed to do work which could be performed by a man having but one arm, and he was paid on that basis. By the loss of his leg such capacity as he had for work was entirely destroyed, and under the provisions of the statute he was entitled to compensation for total permanent disability. Nor does such construction work any hardship on the company, as the man was employed and paid as a man of limited capacity, and the compensation which the company is required to pay is based on the wages it was paying him as a man of limited capacity. The fact that he may have been predisposed to tuberculosis of the bones did not affect the result, as the evidence showed that the tuberculosis of the left knee developed as a result of the injury."

WORKMEN'S COMPENSATION AND INSURANCE

Industrial Diseases and Workmen's Compensation. Note from Paris correspondent. Lancet, Nov. 1, 1919, 197, No. 5018, 801. — The following extract is taken from the above-mentioned issue of the Lancet:

"The Senate and the Chambre des Députés have just adopted a law placing industrial diseases on the same footing as accidents to workmen. The victims of disease will thus obtain the same benefits as those sustaining accidents, in so far as the responsibility of the employers is legally recognized for both. Insurance companies covering employers' liabilities will thus have to raise their tariffs once again." — K. R. Drinker.

Compulsory Sickness Insurance Propaganda. Report of the Committee on a Constructive Plan of Social Insurance, National Civic Federation. The National Civic Federation Review, Jan. 1, 1920, 5, No. 1, 6–7. — There is compulsory health insurance in ten European countries, in seven of which the insurance provides protection only for minorities, and in some cases only insignificant minorities, of the working people. In England the popularity of the measure is due to the fact that the working man pays only four-elevenths of his insurance, the rest being paid by the state and by the employer. Compulsory insurance has never resulted in any relative reduction in appropriations for direct poor relief. Available statistics show that the percentage of sick days has increased both in Austria and in Germany under compulsory insurance. — G. E. Partridge.

An Adventure in State Insurance. *A. J. Pillsbury.* Am. Econ. Rev., Dec., 1919, 9, No. 4, 681–692. — This article follows the development of compensation and insurance in California from the enactment of the Roseberry law in 1911 to the present time. The Roseberry law, the author points out, was crude and tentative, but it served the purpose of establishing the machinery for developing public interest and insuring the passage later of more effective legislation. The Workmen's Compensation Insurance and Safety Act of 1913 was the result of a careful study of insurance in different parts of the United States and of the world. This bill provided for a state compensation insurance fund which was to be used eventually in fair competition with other insurance carriers.

Among the objections to the establishment of a state insurance fund, which the writer meets, are:

1. The insurance field belongs to private enterprises.
2. Politics will get into the management of the fund.
3. Bad risks would fall to the state fund.
4. Private enterprise can do business cheaper.

In offering refutation to the last of these objections

the writer freely admits that it is probable that private enterprises can do business more cheaply than the state, but that they are apt not to, especially when they are not competing with the state.

Since the establishment of the state fund about 40 per cent. of the business of insuring risks covered by the compensation law has fallen to the state. The state fund has been able to " furnish insurance coverage to its patrons for one third less than it has cost those employers who placed their insurance with private insurance companies." Furthermore, there has been built up a reserve within the fund of $1,038,-958.96 to cover unusual risks.

The writer feels that the success of this " adventure in state insurance " warrants the assurance that, should the state at some future time assume risks not now provided for, it can administer added responsiblities with the same success as has marked its work as an insurance carrier up to the present time. — C. H. Paull.

INDUSTRIAL MORTALITY AND MORBIDITY STATISTICS

On the Hygiene of Transportation Workers. *S. Merkel.* Öffentliche Gesundheitspflege, 1917, No. 7, 350–367. — This is mainly a statistical study of the mortality rate, the sanitary conditions and the diseases incident to transportation occupations; but the author has also presented valuable data for the study of the health conditions of a variety of occupations. The evidence on the whole is that transportation occupations are unfavorable to health. A table showing the frequency of diseases among transportation workers in Nürnberg indicates a very high rate of sickness. The accident rate in these occupations is also high. Long hours, exposure, fatigue, strains and the tendency to use stimulants contribute to the unfavorable conditions. The agreement of the transportation workers union with employers in 1910, seeking to remedy the conditions, is given in detail.

As is the case with many statistical studies of the hygienic factors in industry, it is difficult in regard to this one to distinguish between the effects of the occupation itself and the selective process by which its personnel is determined. It could remain a question, for example, whether the high percentage of ill health among drivers results from the insanitary conditions of their work or from the inherent qualities and native habits of the class of men engaged. — G. E. Partridge.

On the Proper Use of School Medical Statistics. *J. Priestley.* School Hygiene, March, 1919, 10, No. 1, 15–27. — The paper is of interest to any one who is concerned with the technique of medical statistics. Standardization of inspectors, the equal representation of inspectors in composite reports, and homogeneity of groups are the main factors considered. " The only safe procedure is to compare an inspector with himself, and this is the only method to be trusted to for really exact and scientific work." — G. E. Partridge.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

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CONTENTS

GENERAL

SEVENTH ANNUAL REPORT OF THE SECRETARY OF LABOR FOR THE FISCAL YEAR ENDED JUNE 30, 1919. U. S. Dept. Labor, Washington Government Printing Office, 1919, pp. 304. — The sections in the 1919 report of the Secretary of Labor of interest in connection with industrial hygiene are those dealing with the organization of the Divisions of Industrial Hygiene and Medicine and of Safety Engineering, and the section devoted to minimum standards for children entering employment.

The function of the Division of Industrial Hygiene and Medicine, in the words of the report, " was to protect and improve the health of those employed in industry and thereby facilitate production. The program dealing with industrial health recognized two fundamentals — control over physical working conditions is in the hands of the management, and the approval and co-operation of workers are necessary to make equipment and regulations effective. Both workers and management may appreciate the value of good health, but the problem of what constitutes a sanitary work place, what processes and materials are harmful to workers, involve scientific research and determination by specialists. To furnish this scientific information and advice is properly the function of the government. The only effective and constructive method is to find out what conditions cause sickness and secure the elimination of those conditions. By such preventive methods industrial losses through sickness can be reduced and the field for curative methods minimized. The researches of the division, therefore, cover three main fields:

" 1. General hygienic conditions in industries in order to determine wherein existing conditions both within and without the plants comply with sanitary requirements.

" 2. Special occupational diseases and poisonings, to ascertain cause, effect, and prevention.

" 3. Physiological requirements of various occupations as the basis for developing methods of proper placement of workers with regard to physical ability."

The function of the Division of Safety Engineering was to reduce accident hazards in industry, a very important part of the work being to teach workers and to provide the information to secure intelligent safeguarding on their part.

The minimum standards for children entering employment, as given in the report, include the subjects of age minimum for different occupations, educational minimum, physical minimum, hours of employment, minimum wage, placement and employment supervision. — K. R. Drinker.

LABOR LAWS OF THE STATE OF CALIFORNIA, 1919. Bureau of Labor Statistics, State of California, pp. 261 with index. — This pamphlet is a compilation of the labor laws of the state of California including the

legislation passed at the 1919 session of the legislature. Digests are presented of the laws relating to apprenticeships, mechanics' liens and convict labor, and the more important decisions on labor laws are printed in full.

The sections of particular interest to the subject of industrial hygiene are those entitled Child Labor, Educational Rights of Children, Part-Time Education, Hours of Labor of Females, Hours of Labor and Days of Rest, Sanitation, Safety of Workmen, Workmen's Compensation, Insurance and Safety Act, and Vocational Re-education of Workmen. — M. Shorley.

Union Scale of Wages and Hours of Labor, May 15, 1918. U. S. Bur. Labor Statis., Bull. No. 259, Oct., 1919, pp. 295. — The title of this pamphlet describes in brief its contents. For details interested readers are referred to the original. — K. R. Drinker.

Minimum Wage Commissions, Current Facts, January, 1920. Compiled by *Mary W. Dewson* for the National Consumers' League, 44 East 23d Street, New York City. Pp. 15. — This pamphlet summarizes the main facts in regard to minimum wage legislation — which states and countries have it, why legislation is needed, what the best minimum wage laws provide, and how the laws are administered. — C. K. Drinker.

Third Annual Report of the Federal Board for Vocational Education, 1919. Washington Government Printing Office, 1919. — A report in two volumes. Volume I deals with the subject of vocational education, its progress and needs, giving a summary of its progress by states; while Volume II takes up the subject of vocational rehabilitation. — K. R. Drinker.

Health Hazards in the Industries of Niagara Falls, N. Y. *Paul M. Holmes.* U. S. Pub. Health Ser., Pub. Health Rep., Jan. 2, 1920, 35, No. 1, 1-20. — A request from the Employers' Association of Niagara Falls asking permission of the federal government to introduce women into shift work resulted in an investigation by the Woman in Industry Service of the Department of Labor upon (1) the hygiene and sanitation in the plants, with recommendations for correcting faulty conditions, and upon (2) the extent to which women might be employed if war conditions should necessitate their going into the plants in increasing numbers. Data and information obtained in this survey are herein given, with conclusions and recommendations. — L. A. Shaw.

Night Work in English Bakeries. U. S. Bur. Labor Statis., Month. Labor Rev., Oct., 1919, 9, No. 4, 147-149. — The above article is an editorial on the report of the British committee appointed "to inquire into the practice of night work in the bread baking and flour confectionery trade, and to report whether it is desirable in the interests of those engaged in the trade and of the community that the practice should be abolished or modified."

"The committee strongly recommends that wherever possible night work shall be abolished by agreement between employer and employee, but as it is improbable that such agreements could be obtained throughout the whole industry it recommends legislation making it unlawful to employ any person in the manufacture of bread or pastry between the hours of 11 P.M. and 5 A.M. Doughmen and oven firemen and their assistants who must necessarily begin their work a few hours before the regular force comes on are excepted from this prohibition, and careful provision is made to cover any emergencies or exceptional circumstances. Finally, in order to prevent any hardship which might arise from too sudden a change, it is recommended that such legislation shall not become effective until two years from its date of passage." — K. R. Drinker.

The Physician and Surgeon in the Industrial Era. *Otto P. Geier.* Surg., Gynec. and Obst., Jan., 1920, 30, No. 1, 44-49. — A splendid plea that the physicians and surgeons of America should take more interest in industrial medicine, emphasizing the reasons why an active participation in industrial medicine is important not only from the medical but also from the sociological and political points of view. — C. C. Lund.

Uses of Motion Pictures in Industrial Diseases. *Leslie W. Sprague.* Mod. Med., Oct., 1919, 1, No. 6, 496-498. — A discussion of the possibilities and the need of motion pictures for educational purposes in industrial medicine. — A. B. Emmons.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Cancer: Facts Which Every Adult Should Know. U. S. Pub. Health Ser., Keep Well Series No. 6, 1919. — This is a small booklet covering the essential facts known to be effective in the control of cancer, and designed especially to acquaint lay readers with the early symptoms and seriousness of the disease in order that afflicted persons may act on this knowledge and place themselves in competent medical hands while the disease is still in a curable stage. — K. R. Drinker.

MENTAL

Success and Failure as Conditions of Mental Health. *William H. Burnham.* Ment. Hyg., July, 1919, 3, No. 3, 387-397. — For the prevention of mental disorder and the development of healthful

habits of mental activity, very simple things are the essential things, and one of these simple conditions is success. In the healthful development of the child and in the efficient activity of the mature individual, success and, to a limited extent, failure also are health conditions of fundamental importance. In its simplest terms, success means the association of reality with a mental image. We get satisfaction from matching that mental image with reality. From continued success through many years, an attitude of confidence is developed. Continued failure, on the other hand, is liable to develop an unsocial attitude, the shut-in personality, and to plant the seeds perhaps of mental disorder. Application of the psychology of success takes the sting out of worry; worry may even become a condition of success, and when we face our worries and analyze them, that very activity may destroy the worry itself. It is chronic worry that kills and not the brief and intense worry that soon ends in the grand and glorious feeling of success. Children should be trained and adult workers should train themselves to make their period of work one day, to live one day at a time.

Mental hygiene also has words of encouragement for those who fail. The help comes in the insight that, after all, the doing itself is the significant thing, that the fun is in the fight, and that the battle of life is worth making for its own sake. By becoming habituated to difficult situations we gain the insight that doing is itself worth while. Thus, even if the end result is apparently a failure, the whole effort is in itself successful. The need of success as a wholesome stimulus is universal. Children have an enormous appetite for it. They need large doses. Adults become depressed without it. It is vital for the normal. The diseased are often cured by it. The fact that you can do well certain things that are worth while gives zest to your life. S. Cobb.

CIRCULATORY SYSTEM

Blood Pressure of Aviators. *Georges Ferry.* Bull. de l'Acad. de méd., Oct. 14, 1919, 82, No. 31, 188. Abstracted as follows in Jour. Am. Med. Assn., Dec. 6, 1919, 73, No. 23, 1804. — "Ferry explains the two main phases of aviators' asthenia, and comments on the depressing and sclerosis-inducing action on the human organism of aviation, and on means to stave this off as long as possible by rest, diuretics, epinephrin, and heart tonics."

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

The More Common Gases: Their Effect on the Respiratory Tract. (Observation in 2000 Cases.) *Robert S. Berghoff.* Arch. Int. Med., Dec., 1919, 24, No. 6, 678–684. — The author concludes:

"1. That gas victims, irrespective of the type of gas and severity of attack sustained, show no marked predisposition toward active pulmonary tuberculosis or toward the reactivation of a healed or quiescent pulmonary lesion.

"2. That gas victims present little evidence of material destruction of lung tissue.

"3. That gas victims with emphysema findings have a more protracted convalescence than those of the bronchitis group." — W. Herman.

Blood and Bone Marrow in Yellow Cross Gas (Mustard Gas) Poisoning. Changes Produced in the Bone Marrow in Fatal Cases. *E. B. Krumbhaar* and *H. D. Krumbhaar.* Jour. Med. Research, Sept., 1919, 40, No. 3, 497. — It is concluded that:

"1. Yellow cross or mustard gas exerts in the bone marrow a direct toxic action which, by depleting the leucocytes of the circulation, has an important bearing on the inability to resist secondary infection that is found in that form of gas poisoning.

"2. This toxic action in the bone marrow is shown not only by small areas of necrosis but by an inhibition of the regenerative process (chiefly of the leucogenetic series).

"3. Not only is the amount of regenerative hyperplasia inadequate to the severity of the process (as compared with the marrow hyperplasia of various acute infections), but also the quality is inferior; that is, the great majority of the hemopoietic cells present are of immature types." — W. Herman.

Mustard Gas. *E. K. Marshall, Jr.* Jour. Am. Med. Assn., Aug. 30, 1919, 73, No. 9, 684–686. — An article dealing with the extreme toxicity, the symptoms and systemic effects, and the mechanism of action of mustard gas (dichlorethylsulphid). — K. R. Drinker.

Poisoning with the Lethal War Gases (Physiology and Experimental Treatment). *Frank P. Underhill.* Jour. Am. Med. Assn., Aug. 30, 1919, 73, No. 9, 686–689. — An article dealing with poisoning with chlorin, phosgen and chlorpicrin, the cause of death, and the method of treatment. — C. K. Drinker.

Gangrene Following Carbon Monoxid Poisoning. *J. Emmons Briggs.* Jour. Am. Med. Assn., Aug. 30, 1919, 73, No. 9, 678–679. — In this article Briggs reports a case of extensive gangrene of the hands and feet involving skin, muscle, tendon, periosteum, bone and joints, and resulting from poisoning with carbon monoxid. The author cites also two similar cases previously reported in the literature. — K. R. Drinker.

Metabolism in Mercuric Chlorid Poisoning. *A. Barlocco.* Riforma Medica, Oct. 4, 1919, 35, No. 40, 845. Abstracted as follows in Jour. Am. Med. Assn., Dec. 20, 73, No. 25, 1907. — "Barlocco analyzes the findings of the intermediate metabolism in nine cases of acute mercuric chlorid poisoning. The

curve of azotemia rises and falls inversely to the diuresis."

Normal Copper in Toxicology. *L. P. J. Palet.* Semana Médica, Aug. 7, 1919, 26, No. 32, 151. Abstracted as follows in Jour. Am. Med. Assn., Dec. 20, 1919, 73, No. 25, 1909. — "Palet's research on fifty-four cadavers failed to confirm the presence of copper in the normal human liver. Incineration with magnesium oxide he found a simple and reliable means of investigating the copper content of tissues."

Precautionary Measures to Prevent Lead Poisoning. U. S. Pub. Health Ser., Pub. Health Rep., Dec. 19, 1919, 34, No. 51, 2905–2907. — The office of industrial hygiene and medicine of the United States Public Health Service has recently concluded a survey of the pottery industry, located chiefly in Trenton, N. J., and East Liverpool, Ohio. The dust and fumes of lead cause more sickness among workers than is caused by any other metal. Over one-half of all the serious cases of metal poisoning are due to lead. Nine-tenths of all lead poisoning can be prevented by keeping dust and fumes from entering the mouth and nose of the worker. Rules are given which, if observed, are calculated to prevent all but an insignificant number of cases of lead poisoning. — L. A. Shaw.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Status of Prophylactic Vaccination Against Influenza. *G. W. McCoy.* Jour. Am. Med. Assn., Aug. 9, 1919, 73, No. 6, 401–404. — The author concludes: "The general impression gained from uncontrolled use of vaccines is that they are of value in the prevention of influenza; but, in every case in which vaccines have been tried under perfectly controlled conditions, they have failed to influence in a definite manner either the morbidity or the mortality." — K. R. Drinker.

Tuberculosis from the Angle of an Expert. *E. O. Otis.* Mass. Dept. Health, The Commonhealth, Sept.-Oct., 1919, 6, No. 5, 199–205. — An outline of the principles which the health officer, visiting nurse, and social workers should have as a guide in tuberculosis work. A reduction in tuberculosis lessens state expenses to such an extent that the campaign against tuberculosis has now come to be considered primarily an economic problem. — L. A. Shaw.

Neighborhood Organization vs. Tuberculosis. *N. A. Nelson.* Mod. Med., Oct., 1919, 1, No. 6, 515–521. — This article describes the work of the National Social Unit Organization in a representative section of Cincinnati, in connection with which "a neighborhood organization has been built up which has led to an unprecedented neighborhood interest and co-operation."

"In the field of tuberculosis, the Unit Organization has succeeded, through its intensified service, coupled with the unusual neighborhood co-operation, in increasing total cases handled 373 per cent., new cases, 616 per cent., and cases carried over, 552 per cent. . . . Only 2.9 per cent. of its cases were lost through lack of co-operation; and from the point of view of age-groups reached, all data is undeniably in favor of the unit plan of organization, and all at a cost of nearly 50 per cent. less." — A. B. Emmons.

Climate in the Treatment of Tuberculosis. Week. Bull. N. Y. City Dept. Health, Dec. 27, 1919, 8, No. 52, 409–413. — A discussion of the effects of climate as a factor in the cure of tuberculosis. — L. A. Shaw.

Effects of Hookworm Disease on Mental Development of North Queensland School-Children. *J. H. Waite* and *I. L. Neilson.* Jour. Am. Med. Assn., Dec. 20, 1919, 73, No. 25, 1877–1879. — The authors report the results of a hookworm survey made by the state of Queensland, Australia, the Australian Institute of Tropical Medicine, and the International Health Board in the northern portion of the state of Queensland. Twenty-one per cent. of the total population and two-fifths of the schoolchildren were found to be infected. An investigation was undertaken aimed at measuring the mentality of a large number of infected children and then at comparing the results of the infected group with those of a non-infected group. From the results of their survey the authors conclude that hookworm disease in children produces measurable mental sluggishness, that mental development is retarded in proportion to the massiveness of the infestation, and that prolonged hookworm infection appears to produce cumulative mental retardation. — K. R. Drinker.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

A Case of Cancer Following a Sulphuric Acid Burn. *Daniel R. Mishell.* Jour. Am. Med. Assn., Dec. 27, 1919, 73, No. 26, 1936. — Mishell reports the case of a dye-worker whose hand was burned by a few drops of sulphuric acid in a factory accident. The initial burn left a small ulcerated surface which refused to heal. Three months later the patient noticed an increase in the size of the lesion. Growth continued until the tumor was excised seven months after the accident. Laboratory examination showed the tumor to be an actively growing squamous cell carcinoma. — K. R. Drinker

Wounds of the Eye. *F. Lagrange.* Bull. de l'Acad. de méd., Nov. 11, 1919, 82, No. 35, 292. Abstracted as follows in Jour. Am. Med. Assn., Dec. 27, 1919, 73, No. 26, 1964.—"Lagrange shows that the gravity of injury of the eye depends on whether the ciliary region is involved or not. He says that any medical man should be able to enucleate the eye at need. Even when the foreign body is not in the ciliary body, if the eye is somewhat tender, and there is hypotony, and the nutrition is suffering, it should be enucleated, as also when there is old cyclitis with inflammatory reaction resisting appropriate treatment for several months."

Foreign Bodies Within the Eyeball. *John O. McReynolds.* Jour. Am. Med. Assn., Sept. 13, 1919, 73, No. 11, 818-824. — In the above article the author deals with the location and character of foreign bodies within the eyeball, and with measures of relief and their results. The article ends with the citation of illustrative cases. — M. Shorley.

The Maximum Physiologic Lymphatic Reaction in Deeply Penetrating Wounds of the Eyeball. *E. L. Jones.* Jour. Am. Med. Assn., Sept. 13, 1919, 73, No. 11, 826. — This article discusses the susceptibility of the eyeball to infection from penetrating wounds, and the value of massive mercuric cyanid injections as a method of treatment. — K. R. Drinker.

Burns of the Eye by Lime. Jour Am. Med. Assn., Dec. 6, 1919, 73, No. 23, 1769. — The following is quoted from the above journal:

"The increase in the use of chlorinated lime for household purposes has resulted in a somewhat greater prevalence of burns of the eye by this substance. During July and August some twenty cases were brought to the attention of the National Committee for the Prevention of Blindness. The circumstances in each case were that a sudden explosion of gas from the inside of the can followed the opening of the container, the shower of lime dust usually striking the eyes and face of the victim. In most cases, complete recovery followed, as medical care was usually provided immediately after the accident. The care of such cases usually includes anesthetization with a few drops of 1 per cent. solution of holocain or a 4 per cent. solution of cocain, and then the removal of the remaining particles of the lime. The irrigating fluid should be a weak solution of vinegar to neutralize the caustic effect of the lime. Subsequently, cold applications may be applied to the closed lids, and a mild antiseptic, such as a boric acid solution, dropped into the eye every two or three hours. If the burn is at all extensive, the conjunctival sac may be filled with an antiseptic ointment, which not only relieves the pain but also prevents the adhesion of opposing surfaces. The most serious and important sequel is the adherence of the lid to the globe (symblepharon) when there are two opposing raw surfaces."

Harvesters' Keratitis. *Chenet.* Médicine, Jan., 1920, 1, No. 4, 210.—The slightest excoriation of the cornea is liable to induce a serious corneal ulcer when there is infection in the lacrimal passages. Chenet reports eleven cases of this sort under observation during harvest time, all of whom required surgical measures and all had a certain amount of impaired vision. All the men had chronic lesions in the lacrimal passages. — K. R. Drinker.

The Ultra-Violet and Visible Transmission of Eye-Protective Glasses. *K. S. Gibson* and *H. J. McNicholas.* Technologic Paper of the Bureau of Standards No. 119, June 7, 1919, pp. 48. — In the above paper the authors report the results of the study of eighty-two samples of eye-protective glass in regard to their transmission of ultra-violet and visible radiant energy. For each specimen is given:

1. The trade name under which it is marketed.
2. The company from which it may be obtained.
3. The approximate color.
4. The thickness.
5. The per cent. transmission curve.
6. The total transmission factor for light of equal energy at all wave lengths.

A brief summary is given of the good or bad qualities of the various kinds of glass in comparison with colorless glass as regards protection against ultra-violet radiant energy. — K. R. Drinker.

Electric Accidents Affecting the Ear. *F. Nager.* Cor-Bl. f. schweiz. Aerzte, Nov. 20, 1919, 49, No. 47, 1778. Abstracted as follows in Jour. Am. Med. Assn., Jan. 17, 1920, 74, No. 3, 214.—"Switzerland has averaged from 50 to 100 serious electric accidents in the last few years and the number is increasing. Nager reports a case of injury of the ears from a live-wire accident, and summarizes four similar cases on record. Any part of the ear may be injured by the electric accident and the examiner afterward should bear this in mind as also the possibility of injury from the detonation alone, as the current is short-circuited. The detonation was regarded as the main factor in the personal case described, and the man was given 2,000 francs compensation for the unilateral cochlea injury."

Occupational Lesions in Nasal Septum. *A. Ranelletti.* Policlinico, Sept. 7, 1919, 26, No. 36, 1057. Abstracted as follows in Jour. Am. Med. Assn., Dec. 20, 1919, 73, No. 25, 1907. —"Ranelletti remarks that ulceration and perforation of the nasal septum are the characteristic occupational injury from the production of sodium chlorate by electrolysis from potassium bichromate. In the last three years he found this ulceration in the nasal septum in twenty-five of thirty-eight workers examined, including four with perforation. The thirty-one other workers also presented similar lesions, so that 56.5 per cent. of the sixty-nine workers in the factory had the ulceration, and in 15.7 per cent. of those affected there was perforation. This proportion is less than was reported by Hermann in Germany in 1900, where 79 per cent. of 257 workers were affected. A loose plug of salicylated gauze introduced into each nostril seems the best individual preventive known to date; cotton interferes with breathing."

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Proceedings of the Fifth Annual Meeting of the International Association of Industrial Accident Boards and Commissions (Held at Madison, Wisconsin, Sept. 24–27, 1918). U. S. Bur. Labor Statis., Bull. No. 264, Oct., 1919, pp. 224. — This pamphlet contains a number of interesting papers dealing with the subject of industrial accidents. Among these are: Ohio's Plan of Reaching the Employer Through Monthly Statistical Reports, by Emile E. Watson; What Wisconsin Is Doing to Prevent Industrial Accidents, by G. H. Hambrecht; California's Accident Prevention Campaign, by John R. Brownell; What the New York State Industrial Commission Is Doing to Prevent Accidents, by James L. Gernon; The Vital Importance of Industrial-Accident Prevention in War Times, by Victor T. Noonan; What Pennsylvania Is Doing to Prevent Accidents, by Robert D. Young; What Massachusetts Is Doing to Prevent Accidents, by William W. Kennard; Accident Prevention in Industries in Ontario, by George A. Kingston; What Industrial Commissions Can Do to Prevent Accidents, by Sidney J. Williams; How Should Permanent Partial Disability Be Compensated, by John Mitchell; Arising Out of and in Course of Employment, by George A. Kingston; Amount of Exposure as Fundamental in Accident Study, by Lucian W. Chaney; Why Tabulate Noncompensated Accidents, by L. W. Hatch; The Use of Standard Accident and Compensation Tables, by W. H. Burhop; Should Medical Service Be Limited in Compensation Cases, by Charles H. Lemon; Better Treatment for Industrial Accident Cases, by P. B. Magnuson; Surgical Treatment to Prevent and Minimize Permanent Disabilities, by Francis D. Donoghue; Should Medical Service Be Limited in Compensation Cases, by Frederic M. Williams; Should Medical Services Be Limited in Compensation Cases, by Raphael Lewy; The Compensation of Disability Due to Pre-existing Disease, Aggravated or Accelerated by Accident or Injury, by Meyer Lissner; How Medical Questions Are Handled Under the Workmen's Compensation Act in the State of Washington, by J. W. Brislawn; How Medical Questions Are Handled Under Compensation Act in Massachusetts, by William W. Kennard; How Medical Questions Are Handled Under Compensation Law in New York State, by William C. Archer; The Need of Medical Statistics for Compensation Purposes, by F. H. Thompson; Selection of the Physician Under Compensation Laws, by John W. Mowell; Selection of the Physician in Compensation Cases, by Raphael Lewy; How to Deal with Crippled Workers, by T. Norman Dean; Conservation of Man Power and Rehabilitation of the Industrially Disabled, by Harry E. Mock; and Problem of the Crippled Man in Industry, by Carl Hookstadt. — M. Shorley.

Industrial Accidents. Bull. Penn. Dept. Labor and Industry, Series of 1919, 6, No. 1, pp. 277. This bulletin consists of a series of tables covering industrial accidents reported to the Bureau of Statistics and Information of the Department of Labor and Industry of Pennsylvania during 1918. The tables are made up into four groups, one covering all accidents, one covering fatal accidents, one, compensation cases, and the fourth, a summary of accident data.

"The tables included in Group No. 1 cover a total of 184,844 accidents, including 3,403 fatal accidents, 53,783 cases of a serious nature, where the injury resulted in the loss of more than fourteen days to the injured person, and 127,658 cases of a minor nature causing disability of fourteen days or less. Of the 184 844 accidents covered in this group, 180,680 were cases where males were injured and 4,164 cover accidents to females. The 3,403 fatal cases include 3,379 accidents to males, and 24 accidents to females.

"The tables included in Group No. 2 give detailed information covering these 3,403 fatal cases and show the number which occurred in each county.

"In Group No. 3 the tables cover a total of 69,920 accident cases where compensation has been awarded and paid. Of this number 2,607 were fatal cases, and 67,313 of a serious nature, resulting in a disability of more than fourteen days. Of the 69,920 cases, 68,603 represent accidents occurring to males and 1,317 are female cases. The total amount of compensation paid, covering the 67,313 disability cases, was $4,780,-197, an average of $71 per case. The amount paid and awarded for the 2,607 fatal cases was $6,859,718, an average of $2,631.27 per case. The grand total of the amount paid and awarded in both disability and fatal cases was $11,639,915, or an average of $166.47 for each of the 69,920 accidents covered in these tables.

"Group No. 4 presents a summary of accident data." — K. R. Drinker.

War-Time Trend of Employment and Accidents in a Group of Steel Mills. *Lucian W. Chaney.* U. S. Bur. Labor Statis., Month. Labor Rev., Oct., 1919, 9, No. 4, 222–232. — This article contains data taken from the records of a group of steel mills for the years 1914 to 1918 and for four months of 1919, indicating the effect of war conditions on industrial activity and on accident rates.

After a decline in industrial activity in the iron and steel industry from the middle of 1914 into 1915, during which the curves of accident severity and frequency declined markedly, there came an upward rush of industrial activity, accompanied by an upward trend in the accident rates.

"The highest accident rates for disabling and nondisabling accidents were in the years terminating November, 1916, and January, 1917, while in (the accident) severity (rate) a first peak comes in the year ending January, 1917, with a second peak of the same altitude in the year ending December, 1918. It would thus appear that the calendar year 1916 may be fairly regarded as the summit of the accident wave."

"From the calendar year 1916 onward employment continues to rise, but less rapidly than during the period of adjustment to war conditions. At the same time a downward trend shows itself in all the accident curves. This continues, steadily in the disabling and non-disabling curves, irregularly in the severity curve, until the year ending January, 1918. From that point the severity curve tends to rise, with some irregularities, to the year ending December, 1918. While this rise in severity is going on the other curves continue their downward movement, recording in both cases a lower point than that reached in 1915." Suggestions are offered of possible causative factors to explain the rise in the accident severity rate simultaneously with a fall in the frequency rate. — M. Shorley.

Dangerous and Safe Practices in Bituminous Coal Mines. *Edward Steidle.* U. S. Bur. Mines, Miners' Circular 22, 1919, pp. 110. — This pamphlet consists of a series of photographs illustrating accidents in bituminous coal mining. Before the circular was prepared several reports of state mine departments were reviewed and a list of fifty of the daily accidents in bituminous coal mining compiled. Each of these accidents is illustrated in the circular by a series of three to five photographs showing the dangerous practice causing the accident and the result, and the proper and safer practice. With each series is a brief description setting forth the lesson taught. Besides the photographs of dangerous and safe practices, a number of general underground safety devices, such as mine signboards, are illustrated. — K. R. Drinker.

Plan of Safety Instruction in Public and Parochial Schools. *E. George Payne.* Published by the National Safety Council. — An outline of a method of teaching safety to schoolchildren. — C. K. Drinker.

INDUSTRIAL SURGERY

Care of the Wounded Man in War. *Anthony Bowlby.* Surg., Gynec. and Obst., Jan., 1920, 30, No. 1, 13–21. — A very valuable summary of lessons learned by surgeons during the great war as to the treatment of shock, fractures, and infected wounds. — C. C. Lund.

Débridement. *Dean D. Lewis.* Jour. Am. Med. Assn., Aug. 9, 1919, 73, No. 6, 377–383. — An article dealing with the application and results of débridement in the treatment of wounds. — K. R. Drinker.

War Wounds: Primary and Secondary Suture. *Eugene H. Pool.* Jour. Am. Med. Assn., Aug. 9, 1919, 73, No. 6, 383–387. — An article outlining the general principles and technique of primary suture, delayed primary suture, and secondary suture in the treatment of wounds of the soft parts, wounds of the face, and wounds other than those of the soft parts. — C. K. Drinker.

Primary Suture for Skull Wounds. *E. Chauvin.* Progrès médical, Sept. 20, 1919, 34, No. 38, 371. Abstracted as follows in Jour. Am. Med. Assn., Dec. 6, 1919, 73, No. 23, 1806. — "Chauvin reports eighteen cases with thirteen healing by primary intention after primary suture. The outcome is not known in the other cases or they are still under treatment; only one was still wearing the drain when discharged. He sutured without draining only in four cases, but he never left the drain in place for over three days."

Reconstructive Surgery of the Hand. *John C. Wilson* and *Clarence H. Hyman.* Jour. Am. Med. Assn., Dec. 13, 1919, 73, No. 24, 1811–1817. — The authors, in the above paper, consider the questions of injuries to the soft parts of the hand, tendon injuries, fractures of the carpus and of the metacarpal bone, joint involvement in hand injuries, amputations and the time of operation. The article ends with reports of cases of hand injuries, their treatment, and the results. — K. R. Drinker.

Joint, Nerve, and Other Injuries in War Surgery. *Robert Jones.* Surg., Gynec. and Obst., Jan., 1920, 30, No. 1, 1–12. — If a nerve is simply contused or compressed and has shown Wallerian degeneration, it will early show signs of recovery. Do not wait over two months before operation in an uncomplicated case. It is essential that the surgeon be experienced in neurological surgery to deal with these cases. No interval is too long between injury and operation to preclude recovery after suture. The state of the muscles, tendons and joints is the important factor. The nerve must be approached through normal tissue. Nothing is gained by surrounding the suture line with cargile membrane, vein or fat introduced from without. Bridging with catgut, etc., always has failed. End-to-end anastomosis offers the only hope of cure.

In cases of irreparable musculospiral or posterior interosseus damage, tendon transplantation is an unqualified success. It must, however, be associated with a good technique and careful re-education. Fractures of the femur, simple or compound, should be treated by the Thomas hip splint or the caliper splint. The leg should not be shortened to fill gaps in bone. An ununited fracture of the humerus should be treated by the step cut operation with long steps. Shortening here is unimportant.

In overcoming adhesions of joints and in subsequent manipulations, the joint should be put through its various movements only once. Voluntary movements can be safely allowed and should be encouraged. Flail-joints are frequently the result of excision. In order to preserve function, the extent

of excision should be small, the extension moderate and of short duration, and the after-treatment should aim at ankylosis. Treatment of flail-joints may consist of (a) removal of necrotic bone and scar tissue; (b) correct posture; (c) operative attempts at improved pseudo-arthrosis; (d) production of ankylosis; (e) retention in mechanical apparatus.

This article contains in condensed form the more important lessons that the British surgeons have learned during the war on certain aspects of nerve and orthopedic surgery. — C. C. Lund.

Surgical Problems in the Reconstruction of Peripheral Nerve Injuries. *Charles H. Frazier.* Ann. Surg., Jan., 1920, 71, No. 1, 1–10. — Dr. Frazier has had 550 peripheral nerve cases under his care at General Hospital No. 11. Two hundred and seventy-five have been discharged as recovered, seventy-five have begun to function spontaneously, 150 have been or will be operated on, and the remainder are under operation. He waits three months after the wound is healed to allow spontaneous recovery to begin before considering operation. This time will usually mean about six months from the time of injury.

Dr. Frazier has performed a neurolysis on 20 per cent. of the cases. This operation is clearly indicated when the nerve responds to faradic current. He almost routinely recommends resection and suture in the presence of a spindle-shaped neuroma. It is not good surgery to surround the nerve with transplanted flaps. The ideal bed for a nerve is the plane between a muscle sheath and deep fascia. It is often good to transplant a nerve from a region of scar tissue to such a plane. The flap operation, *suture à distance*, tubulization, and lateral anastomosis operations have been failures from the clinical standpoint, and the author has not used them. The operations used by the author are nerve suture, neurolysis, resection of humerus, nerve transposition and, rarely, nerve transplantation.

In nerve suture the ends of the nerves must be exposed and cut back to healthy fasciculi free from scar tissue. One tension suture of chromic catgut through the entire thickness of the nerve, one centimeter from the free end, with four to eight epineural sutures of the finest silk, suffices to keep the sheath in apposition. The sutures must not crush the ends together or be too loose. There must not be undue tension on the nerve. The after-treatment is of vital importance; massage, galvanism and later faradism, and properly selected exercises must be continued faithfully until voluntary movement has returned. — C. C. Lund.

Observations in Five Hundred Cases of Injuries of the Peripheral Nerves at U. S. A. General Hospital No. 11. *Charles H. Frazier* and *Samuel Silbert.* Surg., Gynec. and Obst., Jan., 1920, 30, No. 1, 50–63. — An illustrated and more detailed article by the same author on the same subject as the article abstracted above from the Annals of Surgery, January, 1920. — C. C. Lund.

A Study of the Causes of Delayed Union and Non-Union in Fractures of the Long Bones. *William L. Estes, Jr.* Ann. Surg., Jan., 1920, 71, No. 1, 40–46. — Estes discusses the various causes of non-union and delayed union. He calls attention to the suspension-traction method of Dr. Joseph A. Blake as a great improvement over former methods of treating compound comminuted fractures. The author thinks that if this method were applied to all cases of delayed union there would be practically no cases of non-union. — C. C. Lund.

Studies in Bone Growth. *F. H. Albee* assisted by *H. F. Morrison.* Ann. Surg., Jan., 1920, 71, No. 1, 32–39. — The authors, in their paper on the experimental and clinical stimulation of osteogenesis by means of triple calcium phosphate injections into the gap between the two ends of a fractured bone, come to the following conclusions: "Cases of fracture, with loss of substance, showed a much more rapid bone growth and union when triple calcium phosphate was injected into the gap between the bone ends than did the controls without its use." Callous formation was greater. "For our entire series of experiments the average length of time for union in cases of fracture treated with triple calcium phosphate was thirty-one days. The average length of time for union in the controls was forty-two days." No toxic or local irritant symptoms were observed from this treatment. — C. C. Lund.

The Treatment of Bone Cavities. *Walton Martin.* Ann. Surg., Jan., 1920, 71, No. 1, 47–61. — The author's summary is as follows:

"1. That complete removal of all the infected bone lining the cavity, of all foreign bodies and of every particle of dead bone is essential.

"2. That in the great majority of cases the cavity must be obliterated to insure healing.

"3. That this is most satisfactorily accomplished by the removal of sufficient portions of the wall of the cavity to allow the soft parts to fall in and fill it up.

"4. That in certain tunnels and cavities near joints some form of plugging may be indicated.

"5. That of the many materials used as plugs the free fat transplants present real advantages." — C. C. Lund.

Treatment of Burns. *G. E. McGeary.* Minnesota Medicine, Dec., 1919, 2, No. 12, 567. Abstracted as follows in Jour. Am. Med. Assn., Jan. 3, 1920, 74, No. 1, 59. — "The preparation used by McGeary is of a waxy consistency with a melting point of 120 F. The formula is: resorcinol, 10 parts; oil of eucalyptus, 20 parts; olive oil, 50 parts; petrolatum, 250 parts; paraffin, 670 parts. Melt petrolatum and paraffin together. Dissolve the resorcinol in alcohol and add to the petrolatum-paraffin mixture while it is hot, to drive off the alcohol. When cool, add the eucalyptus and olive oil."

The Preparation of the Skin for Operation with Solution of Rubber and Ether Instead of Tincture of Iodine. *Angelo Soresi.* Ann. Surg., Jan., 1920, 71, No. 1, 109–110. — The method of making this solution is described. The advantages claimed for it by the author are as follows: (1) It does not irritate the most delicate skin; (2) it necessitates less packing around the incision; (3) if adhesive is used, the dressing holds better. — C. C. Lund.

MALINGERING

A Trial Frame for Eye Malingering. *Frank Allport* and *James R. Smith.* Jour. Am. Med. Assn., July 12, 1919, 73, No. 2, 105. — In the detection of eye malingering the authors have adopted the old method of inserting in a trial frame a "strong convex lens, which excludes vision at a distance of 20 feet, . . . over the patient's good eye, with a plano lens over his supposedly injured or amblyopic eye. Then, with both eyes open, the patient is asked to read the letters on the test chart. Any resulting vision is very evidently the vision which the patient obtains with the supposedly defective eye."

The trial frame used consists of a "reversible spectacle frame, with a plus 6 sphere on one side and a plano lens on the other. . . . There is a cross or X bridge which allows the glasses to be easily reversed and adds very much to the ease with which the test can be made." — K. R. Drinker.

INDUSTRIAL HEALTH LEGISLATION: WORKMEN'S COMPENSATION AND INSURANCE: COURT DECISIONS

Workmen's Compensation Legislation of 1919. Compiled by *Lindley D. Clark.* U. S. Bur. Labor Statis., Month. Labor Rev., Oct., 1919, 9, No. 4, 243–246. — This is a brief compilation of the legislation in the United States during 1919 on workmen's compensation. — K. R. Drinker.

Medical and Hospital Treatment Under United States Compensation Act. *John W. Trask.* Mod. Med., Oct., 1919, 1, No. 6, 489–495. — The author shows the difficulties of simply referring accident cases to hospitals for diagnosis and treatment, and states the advantages of the treatment of patients by one selected surgeon in each hospital. This method secures the personal interest of the surgeon, which is always necessary for the best results. The cheapest service in the end is found to be the best surgeon obtainable. A fee schedule is considered impracticable. Instead, a plan is outlined whereby the charges shall be reasonable for the service rendered. — A. B. Emmons.

When Employer is not Liable for Medical Services. Jour. Am. Med. Assn., July 5, 1919, 73, No. 1, 59. (Radil *v.* Morris & Co. (Neb.), 170 N. W. R. 363.) — The following is quoted from the above journal:

"The Supreme Court of Nebraska holds that, under Section 3661 of the Revised Statutes of Nebraska of 1913, as amended by the Laws of 1917, Chapter 85, Section 6, an employer, who offers to furnish without charge to an injured employee the reasonable services of a competent physician and medicines as and when needed, and within the value and for the time contemplated by the statute, cannot be held liable for such services by such employee, who has refused such offer by the employer and has obtained such services and medicines elsewhere. The court says that the plaintiff in this case sustained an accidental injury while in the employ of the defendant, and as a result of the accident a part of the second finger of his left hand was bruised and fractured and afterward amputated at the joint. He recovered an award from the compensation commissioner on account of the injury, and for $129 expenses incurred for medical and surgical treatment by a physician other than the one regularly furnished by the defendant. The plaintiff argued that, because an operation became necessary, he was therefore at liberty to make his own selection of a physician, and that the defendant became liable under the statute for the reasonable expenses so incurred. But the court is of the opinion that, the employer having been made liable for the services contemplated by the statute, it would seem from the language used that it must have been the legislative intent that he should be permitted to furnish a physician of his own choice, and if his selection is such as would satisfy a reasonable man under like circumstances, the employee would not then be heard to complain. This is the general rule in manufacturing centers, where employers' liability acts with provisions similar to those of the Nebraska act were in effect before the latter was adopted. It seems to the court that the plaintiff's conduct was in effect and within the meaning of the statute an unjustifiable refusal to allow the defendant to furnish the reasonable services and medicines that the act contemplates, and that the defendant was not therefore liable for the medical expenses that he incurred. Wherefore a judgment of the district court, which disallowed the bill for $129 for medical services, is affirmed."

Right to Select Physician or Hospital Under Workmen's Compensation Act. Jour. Am. Med. Assn., July 5, 1919, 73, No. 1, 58. (Leadbettor et al. *v.* Industrial Accident Commission (Calif.), 177 Pac. R. 449; Cella *v.* Industrial Accident Commission et al. (Calif.), 177 Pac. R. 490.) — The following is quoted from the above journal:

"The Supreme Court of California says, in the Leadbettor case, that the workmen's compensation act of that state (Section 15a) imposes on the employer the duty to provide medical, surgical and hospital treatment, and, 'in case of his neglect or refusal seasonably to do so,' makes him liable for the reasonable expense incurred by the employee in providing the treatment. The intent of the act obviously is that the employer shall, in the first instance, have the right to designate and select the physicians who are to give treatment to the employee. The latter is authorized to make his own selection at the expense of the employer only when the employer has neglected or refused to provide the necessary service.

"The District Court of Appeal of California, First District, Division 1, in affirming, in the Cella case, an order of the commission refusing to make an award in his behalf covering hospital charges, says that he was injured while in the employ of a company, and was told by the company's physician to go to the St. Francis Hospital. He did not do so, but went to St. Joseph's Hospital. He claimed that he did this through ignorance, being an Italian who could neither read, write nor speak English. However, the fact was clearly established that he was directed to go to the St. Francis Hospital and the address was given in writing. These facts did not show any neglect or refusal on the part of the company to furnish him hospital service. Yet it is clear that the commission could not make an award to him for such services except it be first shown that the company had neglected or refused to furnish such service. The commission did not exceed its jurisdiction in refusing him an award."

Duty to Provide Prompt Emergency Treatment. Jour. Am. Med. Assn., Aug. 23, 1919, 73, No. 8, 632. (Fontanello *v.* New York Cent. R. Co. (N. Y.), 174 N. Y. Supp. 537.) — The following is quoted from the above journal:

"The Supreme Court of New York, Appellate Division, First Department, expresses a willingness to affirm a judgment in favor of the plaintiff, provided he is willing to reduce the verdict in his favor from $20,000 to $12,000, in this action that was brought, not for the original injury, but for the injury alleged to have arisen from the neglect of the defendant to provide prompt emergency treatment, by reason whereof the plaintiff's leg was necessarily amputated. The court says that while the plaintiff, a foreman for the defendant, was at work at a manhole, the cover of the manhole fell on him and broke his leg. That was between 9:30 and 9:45, or very near that time, in the morning. He was taken to an emergency hospital which the defendant had established, reaching it just after 10 o'clock. The physician whose duty it was to be there at that time had not arrived, having been delayed by the failure of his motor car. The assistant station master, who seemed to have charge, telephoned for him and found that he was not in his office, then tried to get another of the company's physicians, and finally telephoned to another hospital for an ambulance to take the man to that hospital, the assistant station master testifying that that message was sent between 10:20 and 10:30 A.M., while the surgeon connected with the other hospital, who came for the plaintiff, swore that the message was not received until after 11 o'clock. The testimony in the case further showed that, immediately on the happening of such an accident, infection sets in; that a wound with this liability to infection requires prompt, if not immediate, emergency treatment, and that the delay of only a few minutes may permit the development of that infection to such an extent as to require the amputation of the limb to save the patient's life. The evidence of the defendant's physician second sought was that he arrived at the hospital at 10:49 and gave to the plaintiff the necessary emergency treatment within a few minutes thereafter; but it seemed that the surgeon of the other hospital was there with the ambulance at nearly the same time, and immediately after the emergency treatment the plaintiff was taken to that hospital. The jury found, on what the court must deem was sufficient evidence, that the delay of approximately an hour at the emergency hospital permitted the infection so to develop that it became necessary, by reason thereof, to amputate the plaintiff's leg. It also found that the defendant had not used reasonable care in providing prompt emergency treatment. For the negligence of the first physician in failing to get to the emergency hospital the trial judge correctly charged that the defendant was not liable. The liability found by the court below was placed on the negligence of the assistant station master in charge of the emergency hospital in failing for an hour to send for an ambulance from the other hospital. A corporation must always act through its agents, and public policy would seem to require that in the providing of prompt service, when prompt service may be vital to the welfare of the patients, as well as in the providing of competent surgical and nursing attention, such an institution is under the duty to use reasonable diligence. Such a duty is not one that can be delegated, but is one which rests primarily and always with the institution, and for the negligence of the assistant station master in failing to provide prompt emergency treatment in this case the defendant was properly held responsible."

Report of the Pennsylvania Health Insurance Commission. Editorial. Jour. Am. Med. Assn., Sept. 13, 1919, 73, No. 11, 858–859. — The following is quoted from the above journal:

"The report of the Health Insurance Commission of Pennsylvania, just issued, is necessarily a limited one. The commission was directed by the act of July 25, 1917, to investigate 'the extent, loss and causes of sickness and accidents of employees and their families not covered by the workmen's compensation act; the adequacy of the present methods of treatment and care of such sickness or injury; the adequacy of the present methods of meeting the losses caused by sickness or injury, either through insurance or otherwise; the influence of working conditions on the health of employees, and the meth-

ods of sickness prevention with a view to recommending ways and means for the improvement of the health of employees and their protection against sickness and accident,' and for all this work the legislature provided the liberal appropriation of $5,000. Naturally, the commission was not able to make any investigation, but confined itself to collecting and arranging material gathered by other agencies. It reports that there are constantly ill in the state more than 385,000 employees, of whom approximately 140,000 are subjects of severe illness and 245,000 less serious. The average loss of working time on account of sickness is at least six days per annum for each employee. . . .

" Regarding financial loss due to sickness, the commission estimated the wage loss to employees at $33,000,000 a year. The losses to employers consist of decreased production and cost of labor turnover. During the influenza epidemic, anthracite coal production in Pennsylvania, the largest coal producing state in the Union, dropped 500,000 tons in a few days. The losses to the community consist of direct money loss and social loss. The state spends more than $6,000,000 each year directly for the treatment of sickness, and $4,000,000 for the maintenance of institutions for the care of defectives. In addition to public institutions, 175 hospitals report that, in 1916, 57 per cent. of their patients were treated free. The commission finds that wage earners are not receiving satisfactory medical care. Hospital accommodations in the state average a little more than one-half the recognized minimum of five beds per thousand. Approximately one-fourth of those actually disabled by sickness never receive medical care. Insurance protection against sickness was found among only 30 per cent. of employees. The lower the wage group, the least likely the insurance protection. Such insurance as was carried seldom provided proper medical care. Lodges, fraternal societies and trade union funds afford little better protection.

" The commission is of the opinion that industry is clearly responsible for a large proportion of the illness among employees; that fully one-half of the existing sickness could be eliminated by proper preventive methods; that from 70 to 75 per cent. of the schoolchildren of the state are physically defective, and that most of the defects are or were correctable; and that a large number of communities in the state have no active health work nor adequate appropriations for health activities. Regarding responsibility, the commission holds that this rests on three groups, the community, the industry and the individual, and that at present these groups are meeting the losses for illness in unequal share. The burden on the individual is often disastrous and out of proportion to his individual responsibility or ability to carry it, and some means of a just distribution of this burden should be found. There is in Pennsylvania today, in the opinion of the commission urgent need for a program that will provide efficient care for employees and their families when ill and preventive measures that will as far as possible prevent illness and increase the health and vigor of the citizens of the state. No definite health insurance measures were recommended by the commission. Instead, it recommended that a new commission be appointed to continue the investigation and to study proposed and existing schemes of health insurance in this and other countries with a view to formulating definite measures. The appropriation of $5,000 for such a commission was, of course, ridiculously inadequate. The problem as shown by the report of the commission would justify the expenditure of any amount of money for a clearer understanding or a solution of the problem."

REHABILITATION OF DISABLED EMPLOYEES

Reconstruction of the Disabled. Am. Jour. Care Cripples, June, 1919, 8, No. 6, 405-474. — This issue of the American Journal of Care for Cripples contains a number of interesting articles on reconstruction work among disabled soldiers. Among these are: Experience in the Re-education of Disabled Soldiers in Great Britain, by Douglas C. McMurtrie; Re-educational Work Among the Serbs in France, by Aline S. Atherton-Smith; The Reeducation of Blinded Soldiers, by Professor Francesco Denti; Occupational Therapy, by Major Bird T. Baldwin; Lessons from Reconstruction Hospitals, by Captain L. A. Pechstein; The Employment Office for the Severely Disabled of the Third Army Corps and the Province of Brandenburg, by Drs. W. and H. Beckmann; Vocational Guidance and the Provision of Employment for the Tuberculous, with Special Reference to the War Disabled, by Dr. Freudenfeld. The article by Professor Denti is a translation from the Italian, while the last two papers are translations from German articles. For greater detail, interested readers are referred to the originals of these various papers. — M. Shorley.

Practical Experience in Dealing With Industrial Cripples. *Dudley M. Holman.* Am. Jour. Care Cripples, June, 1919, 8, No. 6, 438-441. — In this paper the author discusses the question of the re-education of industrial cripples, citing examples of injured men who, by re-education after injury, were enabled to earn even better wages than before their accidents. The main point which Mr. Holman emphasizes is his belief that the re-education of industrial cripples is not a job for the federal government but as a matter of policy and of business principle should belong to the insurance carriers. He believes that by spending money freely on the thorough treatment of industrial cripples by the best surgeons and in the best hospitals, and by subsequent reeducation insurance carriers will not only return men to useful and self-supporting work but will, in the end, save money for themselves. — K. R. Drinker.

INDUSTRIAL MORTALITY AND MORBIDITY STATISTICS

Bituminous Coal Mine Fatalities in Pennsylvania, 1914 to 1918 Inclusive. U. S. Bur. Labor Statis., Month. Labor Rev., Oct., 1919, 9, No. 4, 233–234. — This article is a brief review of an analysis of bituminous coal mine fatalities in Pennsylvania for the five-year period, 1914 to 1918, recently made under the direction of the state insurance department and based on the records of the Department of Mines. A table is given showing the production of bituminous coal mines in Pennsylvania and the fatality rates per thousand 250-day workers and per million tons mined during the years 1914 to 1918. "During this five-year period 57.2 per cent. of the fatalities were caused by falls of roof and coal, and 26.1 per cent. were chargeable to mine haulage.

"A table of compensation costs covering the period, 1916 to 1918 inclusive, shows a total of $2,800,737 paid in benefits on account of 732 fatalities and 456 permanent disabilities. Of the total of 281 specific injuries, 154, or 54.8 per cent., involve injury to eyes." — K. R. Drinker.

SUBJECT INDEX TO VOLUME I

This is a subject index to all the reading matter in the ABSTRACT OF THE LITERATURE OF INDUSTRIAL HYGIENE and one should, therefore, look for the subject word. The name of the author follows the subject entry in brackets.

For author index see page 212.

AUTHOR INDEX TO VOLUME I

The Journal of industrial
hygiene and toxicology